Critical Release Notice

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The content of this customer NTP supports the SN06 (DMS) and ISN06 (TDM) software releases.

Bookmarks used in this NTP highlight the changes between the baseline NTP and the current release. The bookmarks provided are color-coded to identify release-specific content changes. NTP volumes that do not contain bookmarks indicate that the baseline NTP remains unchanged and is valid for the current release.

Bookmark Color Legend

Black: Applies to new or modified content for the baseline NTP that is valid through the current release.

Red: Applies to new or modified content for NA017/ISN04 (TDM) that is valid through the current release.

Blue: Applies to new or modified content for NA018 (SN05 DMS)/ISN05 (TDM) that is valid through the current release.

Green: Applies to new or modified content for SN06 (DMS)/ISN06 (TDM) that is valid through the current release.

Attention!

Adobe® Acrobat® Reader™ 5.0 is required to view bookmarks in color.

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DMS-100 Family

Loading

Administration Guide

BASE03 Standard 03.02 July 1998

northern telecom

DMS-100 Family

Loading

Administration Guide

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Contents

About this document

When to use this document

This guide provides methods and procedures for monitoring the traffic load on a DMS-100 switch and guidelines to the switch administrator for balancing the load offered to the switch components.

How to check the version and issue of this document

The version and issue of the document are indicated by numbers, for example, 01.01.

The first two digits indicate the version. The version number increases each time the document is updated to support a new software release. For example, the first release of a document is 01.01. In the *next* software release cycle, the first release of the same document is 02.01.

The second two digits indicate the issue. The issue number increases each time the document is revised but rereleased in the *same* software release cycle. For example, the second release of a document in the same software release cycle is 01.02.

More than one version of this document may exist. To determine whether you have the document that applies to the software in your office, check the release information in *North American DMS-100 Northern Telecom Publications Cancellation Index*, 297-1001-002.

References in this document

The following documents are referred to in this document:

- *Office Parameters Reference Manual*
- *Operational Measurements Reference Manual*
- *DMS-100 Provisioning Manual*, 297-1001-450

Understanding loading administration

Introduction

Traffic load administration is the management of the DMS-100 traffic load on hardware and software components in a manner that makes the best and most efficient use of the engineered switch capacity. Distributing the offered load equally across all traffic-sensitive components is an essential part of of this administration process. Typically, the administrator monitors the effects of the traffic load on the overall performance of the DMS-100 switch, but most of the activity centers around line modules.

Traffic load administration involves the following activities:

- developing loading plans
- loading new switches
- adhering to the basic rules and limitations of loading
- loading new services into existing peripheral modules and monitoring the affect on the switch
- assigning operational measurements to output reports
- scheduling hours for data collection

Loading plan

A loading plan is a detailed program for assignment of lines, trunks, and associated features to switch modules. The plan may incorporate certain rules and restrictions to those assignments for an individual switch or group of switches.

Due to the inherent flexibility of the DMS-100 switch and its ability to support various products, such as the Traffic Operator Position System (TOPS) and Meridian digital centrex (MDC), loading requirements vary from office to office. Loading requirements also vary depending on individual customer loading plans including business lines and integrated services digital network (ISDN).

An individual loading plan should be developed for each switch, and an overall loading plan should be developed for multientity wire centers. If all the switches in a multientity wire center do not offer the same services and features, the loading plan becomes critical to the proper utilization of the equipment. It may be necessary to direct some subscribers for example, those requiring specific features to one switch while directing other subscribers, such as those who want only basic service, to another switch.

The details of the loading plan should indicate the classes of service distribution across the line modules. This includes the quantity of each line type that may be served by each line module and which services each switch will provide. It is recommended that the network administrator review the results monthly. If this is not possible, the administrator should review the results with each new switch load forecast and periodically as locally determined. Adjustments to the loading plan should be made as required due to forecast changes.

Initial loading of subscriber access lines

The initial loading (assignment to specific equipment) of subscriber access lines to a switch is part of a process used prior to the commissioning of a new DMS-100 office. The process begins when Northern Telecom (NT) receives one or more completed NT-ACCESS questionnaires from the operating company. The questionnaire is the official document that is used to determine the types and amounts of hardware and software required for a particular switch (office). After the hardware and software requirements are determined, initial loading of subscriber access lines can be planned.

There are three basic questionnaires:

- NT8630 DMS-100 Family Order Capture Document (replaces the NT8620 manual document for a host office)
- NT8603 DMS-100 Family Remote Order Capture Document (replaces the NT8602 manual document for remote offices)
- NT8602 Dynamic Network Controller Order Capture Document

Note: NT-ACCESS is an umbrella of systems that that provide fully automated provisioning and pricing capabilities for the DMS-100 Family product line and is designed to streamline the the engineering and order entry process.

General guidelines for initial loading

There are balancing guidelines to follow when attempting to balance the load on the PMs that connect lines to the switch. Lines should be as evenly distributed across these modules by class of service as possible, for example, residential, coin service, and centrex lines.

Traditional methods of load balancing lines by line type are the first steps in balancing the load in the DMS-100 switch. Additionally, load balancing by line type must be performed on an individual peripheral basis. Other items, such as the effects of remote line concentrating (RLC) peripherals and traffic provisioning for grade-of-service (GOS), must then be considered.

Load balancing may not appear to be as critical when a new switch is cut into service or a relief job has just been completed. This is especially true if the switch has been engineered with a substantial amount of capacity provided for growth. However, it is recommended that the administrator strive for load balance during these periods, to minimize any required line rearrangements for balancing purposes as the switch load approaches capacity.

The initial loading process uses estimates of offered load. After the initial loading, the administrator, using empirical data, balances the actual offered load across the line peripherals. This requires some adjustments to the original load estimates.

Data collection

Operational measurements (OM) provide peg counts and usage measurements for traffic-sensitive items which are collected at regular, typically half-hour, intervals. Selected groupings of data are available for the following items:

- groups of equipment
- individual line information
- individual trunk information
- software resources

These measurements provide data for compiling statistical information. The statistics are then used to analyze switch load balance performance and provisioning requirements.

Grade of service

The basic design philosophy of the DMS-100 Family is based on delay criteria from the peripheral originator (line or trunk) up to the network. The network and all terminating paths are designed based upon blockage criteria. Blockage is defined as the failure to find an idle channel and is referred to as matching loss. The rates of delay and blockage are referred to as the grade of service (GOS). The higher these rates become, the lower the GOS that is experienced by the subscriber.

Delay in the DMS-100 Family occurs in the form of dial tone delay (DTD) for originating calls and incoming start-to-dial delay (ISDD) for incoming

calls. The percentage of delays greater than 3 seconds is used to assess the GOS for the overall switch design.

The criteria are 1.5 percent DTD and ISDD greater than 3 s for the average busy season busy hour (ABSBH) and 20 percent for the high day busy hour (HDBH).

Service criteria

Service criteria are those objective levels of call blocking and delay that are set for the measured busy hour. Effective capacity administration will ensure that these service objectives are met. Service criteria have been developed on the basis of judgment and experience. The overall objective is to provide the best possible service at a reasonable cost.

To establish a service standard, it is necessary to have a measurement that quantifies the customer's inconvenience experienced because of call blocking or call delay. When a call is blocked, a tone or message is delivered to the customer who then must hang up to try the call again. When a call is delayed, the customer is only considered to be inconvenienced if the delay exceeds some maximum tolerable value. The DMS-100 Family design applies a mixture of loss and delay criteria.

Loss criteria

All the line modules are engineered to meet objective service levels during the worst case of incoming matching loss (IML) during either the ABSBH or HDBH. Incoming matching loss is defined as that condition when a call cannot be completed because an idle path cannot be found between an incoming trunk and an idle line. Northern Telecom engineering tables are based on IML objectives.

The existing published matching loss criteria are stated for the entire office. They have two sources, peripheral matching loss and network matching loss. The peripheral portion is the predominant part of the HDBH criteria. The recommended incoming matching loss criteria for a DMS-100 switch are shown in the following table.

NT recommended matching loss criteria

Busy hour	Overall	Peripheral	Network
ABSBH	2.0%	1.9%	0.1%
HDBH	5.0%	4.0%	1.0%

Delay criteria

When subscribers and calls are served on a delay basis, the concern is usually more with the duration of the delay than the probability of delay. At the present time, delays of less than 3 s are considered acceptable to the subscriber, or at least they do not annoy the subscriber if it does not happen too frequently.

The delay criteria that are used for engineering purposes are as follows:

- Dial tone delay (DTD) the probability that a customer will experience a dial tone delay of more than 3 s
- Incoming start-to-dial delay (ISDD) the probability that an incoming trunk to a multifrequency receiver will experience a delay of more than 3 s before the receiver becomes available

The current recommended delay criteria are shown in the following table.

Recommended engineered delay criteria

Delay measurement	DMS-100 ABSBH	HDBH	DMS-200 10HDBH	HDBH
Dial tone delay	1.5%	20.0%	see note	see note
Incoming start-to-dial delay	1.5%	20.0%	8.0%	20.0%

Note: Not applicable to this office type.

With configurations that require a high penetration of Meridian Digital Centrex or Multiple Appearance Directory Number (MADN) features, a line peripheral can become limited by high day busy hour attempts. The load service relationship for an attempt limited line peripheral is dial tone delay (DTD). The attempt capacity can be obtained by using the Northern Telecom PRTCALC tool. Staying within this attempt limit maximizes throughput, minimizes any delay caused by the peripheral, and supports an overall DTD of 20 percent during the high day busy hour.

The traffic capacity tables, associated with line peripherals and the PRTCALC program, assume an even (balanced) flow of traffic across all line modules. This PRTCALC function is usually performed by the traffic engineer. The administrator may get the required information from the engineer that is responsible for the office in question.

Measurement methods

The following section describes methods for measuring the capacity in a DMS-100 Family switch. These methods are based on the measurements that are currently available in the data collection system.

Performance indicators

Performance indicators are measurements or records of events that occur during a given period of time or in a time sequence. For the DMS-100 Family switch, performance indicators take the form of operational measurements (OMs) and log reports.

Load balancing considerations

The DMS-100 is designed and equipped to handle a defined amount of traffic load. If the traffic load exceeds the predefined limit, some of the traffic may be delayed or blocked until a server is available or during excessively heavy load periods new requests for service may be denied to avoid overloading the switch.

Line use is based on a unit of traffic sampling called centum call seconds or hundred call seconds (CCS) and is derived by sampling the status of each access line every 100 seconds to determine if the line is idle or busy. If the line is busy at the time of the sample, 100 seconds (one CCS) of use is recorded. If the line is not busy, the use register is not scored The ideal distribution is a configuration with matching quantities of use across all peripheral processors.

Load balancing assumes that lines of the same class of service generate approximately the same use. Lines that deviate from the average use can be identified through line studies. To balance the load, the deviation (excess load) can be moved to other line modules as appropriate. Modules with a higher load than the others can be restricted from additional assignments until the desired load balance is achieved.

The following are some of the factors that affect load balancing:

- lines or trunks with use above or below office average
- changes in number of call attempts
- penetration of multiple appearance directory number (MADN)
- ISDN features
- new feature introductions
- new subscribers with heavy use lines or concentration of features
- types of subscriber equipment

In addition, a mechanized method to measure and control the balance of traffic load offered to like components of the product or system is normally employed. Such measurement methods are developed by the operating company or a vendor. A typical measurement uses the standard operational measurements of use (CCS) provided by the DMS-100 Family switch. The measurement might consist of average line or trunk module use where values are assigned to the busy hour loads of modules that deviate from the average by a selected range of CCS values. For example, +1, +2, +3, for modules above the average and –1, –2, –3 for those below the average where each value represents five percentage points of deviation from the average. Therefore, a value of –3 would represent a deviation of 15 percent or more below the average. The modules that have the largest minus values are assigned to accept new traffic load generated by service order activity for new lines or trunks until their loads equal or nearly equal the average load of all modules.

Hardware configuration

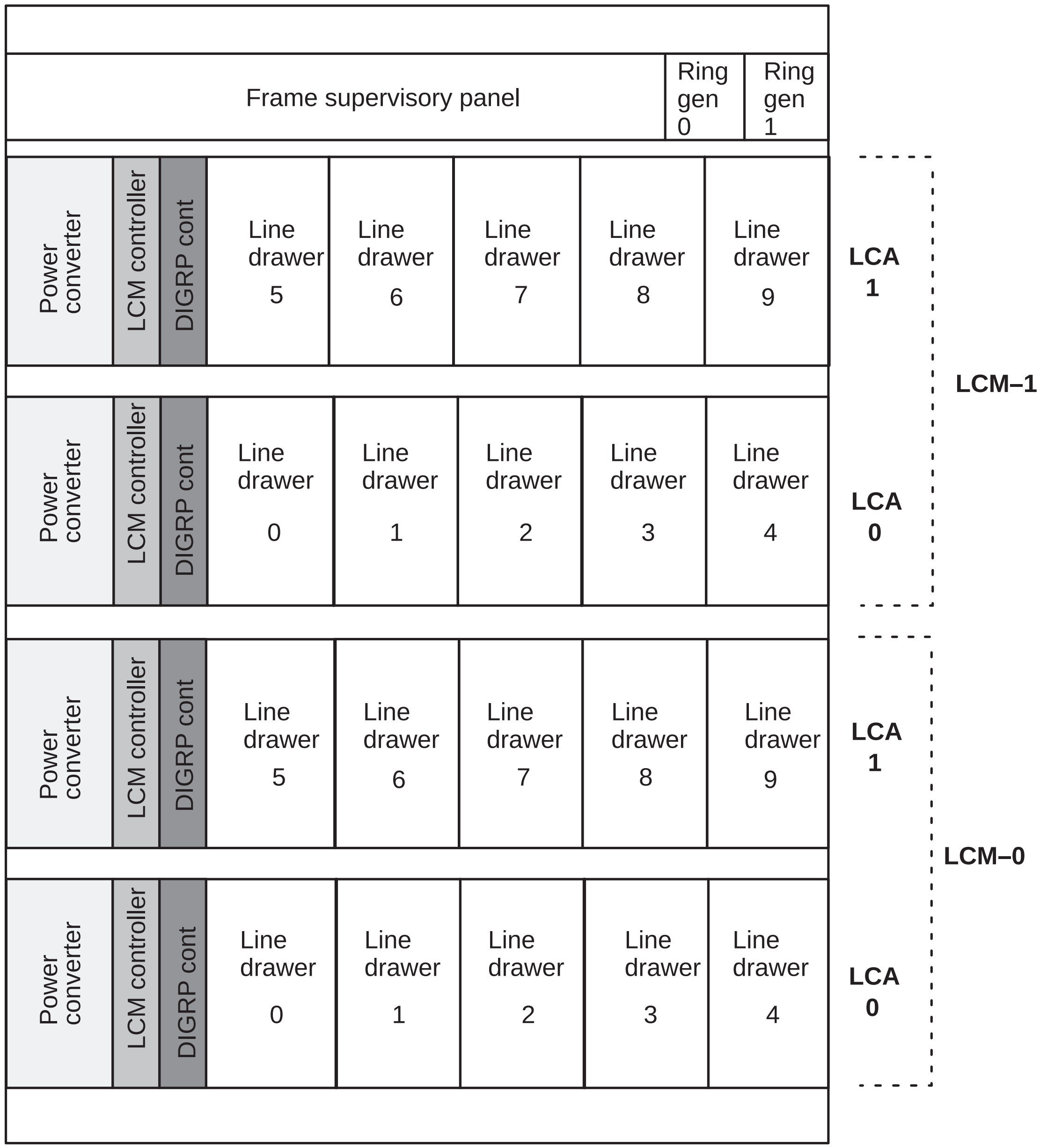
The DMS-100 uses a modular structure to organize lines and trunks in equipment frames. The arrangement of the equipment within the frames provides easy access to line and trunk cards.

Line modules are arranged in subgroups, that are contained within line drawers. These, in turn, are components of larger units known as line concentrating arrays (LCA). Two LCAs are grouped to form a line concentrating module (LCM). As shown in the following figure, a typically loaded line concentrating equipment (LCE) frame contains two LCMs.

Line concentrating equipment frames

The standard LCE frame is a standard DMS frame that houses two dual-shelf LCMs. A fully equipped LCE frame supports 1280 line cards. The following figure shows an example LCE frame.

Line concentrating equipment frame



Note: In an office serving more than one multifrequency (MF) ringing type, lines must be segregated by MF type and must terminate on the appropriate LCE frame.

The principal difference between an LCE and an LCEI is that the LCEI is provisioned exclusively with dedicated ISDN equipment.

Line concentrating module

The LCM provides the interface between the LGC and the network. The LCM, located in the LCE, is composed of two units, 0 and 1.

The LCM is capable of handling 640 POTS lines under most operating conditions. Because the addition of messaging features and terminal equipment can reduce the total number of assigned lines, LCM administration is critical to efficient DMS-100 operation.

Line concentrating module configuration

Each LCM has 640 physical line card slots: 1 slot is reserved for a test line and 639 slots are assigned to subscriber lines. Each shelf of a dual-shelf LCM is known as an LCA.

Depending on traffic loads, the LCM can be provisioned with a minimum of 2 (60 channels) and a maximum of 6 (180 channels) DS30A links. For example, an LCM utilizing the maximum of six DS30A links provides a capacity capability of 8 CCS per line.

Line concentrating module features

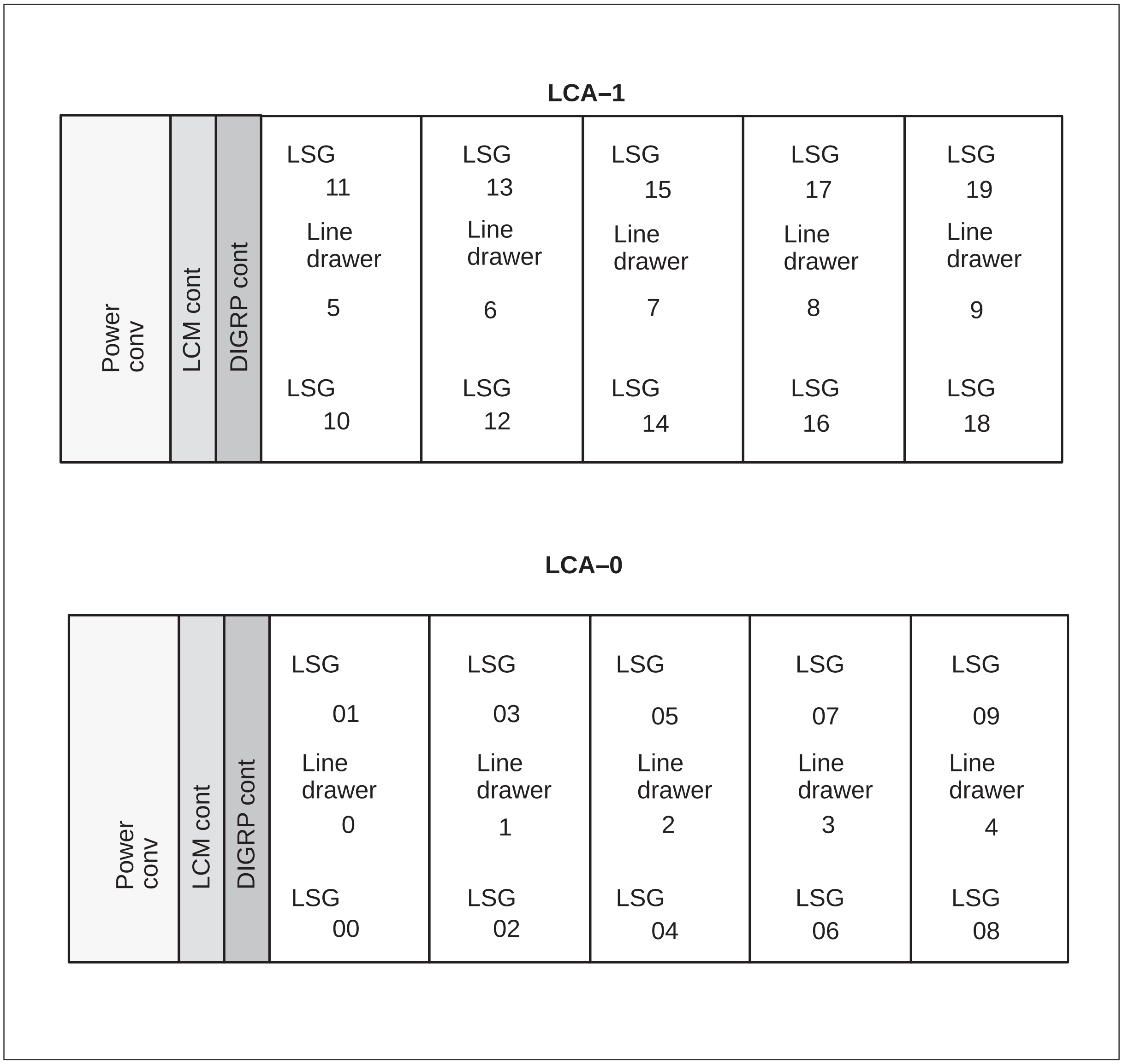
The LCM provides the following features and functions:

- supports a maximum of 640 analog lines
- provides from two to six DS30A links to an LGC
- supports MDC services
- supports voice and data line cards
- performs low-level call processing functions:
  - scanning lines for changes of state
  - collecting dialed digit information
  - monitoring the ringing generator
  - handling messages for the LGC

Line concentrating array

An individual shelf in a dual-shelf LCM is referred to as an LCA. LCA-0 is the lower array in an LCM, and LCA-1 is the upper array. As shown in the following figure, each shelf is equipped with an LCM processor, a digroup controller, a power converter, and five line drawers. A line drawer connects up to 64 line cards arranged into 2 groups with 32 cards in each group.

Line concentrating module



The LSG contains a maximum of 32 line cards. Each line card provides circuitry for one subscriber line. Line cards contain one line circuit each, are available in several configurations, and are used for a variety of circuit and signaling applications.

> ***Note:*** Refer to *DMS-100 Provisioning Manual*, 297-1001-450, for more information.

Line concentrating module line drawer

The LCM line drawer is a grouping of 32 line cards known as a line subgroup (LSG). The line drawer is functionally divided into 2 LSGs of 32 card slots each. LSG-0 is composed of the two lower rows of line card slots, and LSG-1 comprises the two upper rows. Each line drawer has one common circuit pack and can accommodate a maximum of 64 line cards of various types.

The ten line drawers in each LCA shelf are uniquely identified. LCA-0 contains line drawers 0 through 4, and LCA-1 contains drawers 5 through 9. Refer to the LCME line drawer layout figure for a representative line drawer layout.

Enhanced ISDN line concentrating module

The enhanced ISDN line concentrating module (LCME) is a dual-unit peripheral module that terminates ISDN 2B1Q U-type lines, ISDN lines, Datapath lines, electronic business sets (EBS), and plain ordinary service (POTS) lines. It also provides access to the ISDN B-, D-, and M-channels. The LCME has a capacity of 480 U-type (single-slot) line cards or 240 S/T-type (double-slot) line cards. Alternatively, the LCME supports 480 POTS or EBS lines, or 240 Datapath lines.

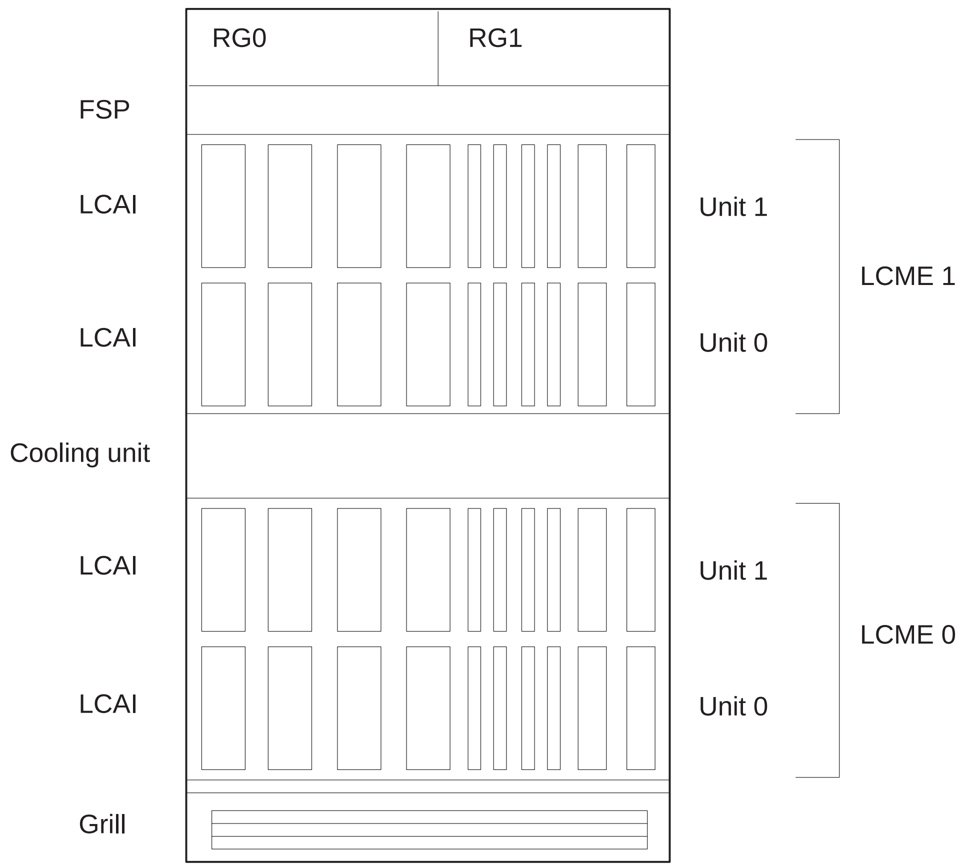
With no drawer-level B-channel blocking, the LCME supports a maximum of 320 (40 per physical drawer) ISDN-only lines (U-type), or a mixture of ISDN U-type, S/T-type, POTS, EBS, and Datapath lines.

LCME configuration

As shown in the following figure, a typical LCME frame houses two LCMEs. Each LCME consists of two units or line concentrating arrays (LCAIs). Each LCAI occupies a separate shelf and consists of the following components:

- four physical line drawers, each providing space for up to 60 line cards (equipped depending on the line types installed)
- four ISDN bus interface cards (BIC), one in each line drawer
- four point-of-power (PUPS), one in each line drawer
- two ISDN digroup controller cards (DCC)
- one LCME processor card
- two power converters
- one to nine DS30A links to the LGC/LTC

Enhanced ISDN line concentrating equipment frame



LCEI BX30AB

FSP	Frame supervisory panel
LCAI	Line concentrating array
LCME	Enhanced ISDN line concentrating module
LCEI	Line concentrating equipment frame
RG	Ringing generator

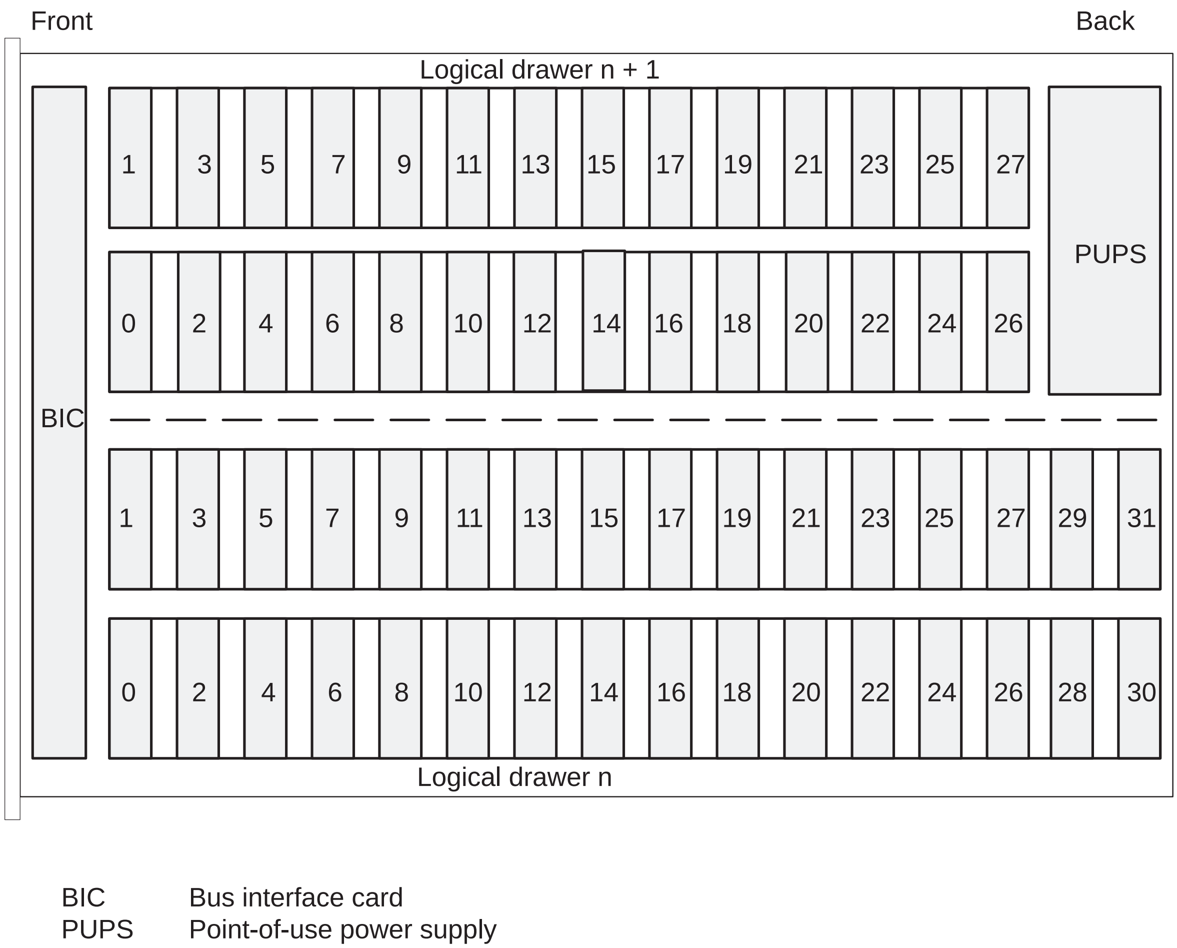
ISDN line drawer

Each ISDN subscriber line terminates on a line card in the line drawer of the LCME. The line cards transmit and receive messages and data between the ISDN line and the bus interface card.

The LCME has eight physical line card drawers (four for each LCAI), Each with space for up to 60 single-slot line cards. Each physical line drawer is divided into two logical line drawers. Each even-numbered logical line drawer has 32 single line card slots, and each odd-numbered logical line drawer has 28 single line card slots. The point-of-power supply (PUPS)

occupies the space of four single line card slots in the odd-numbered logical line drawers in the following figure.

LCME line drawer layout (odd-numbered drawer)



Line cards

Line cards are available in several types and configurations. The following list shows the properties of example line card types.

- card type A
  - — POTS
  - — single, two-party, and private branch exchange (PBX) analog sets

Note: Card types A, B, C, and E require one card slot.

- card type B
  - — supports all the features of type A, plus multiparty lines
  - — coded ringing, PBX ground start, hotel/motel, and analog pay telephone sets requiring coin control
- card type C
  - — interface for the electronic business set (P-phone)
- card type D
  - — provides data interface
  - — only supports the data unit

  Note: Card type D requires two card slots.

- card type E
  - — supports all the features of type A plus message waiting
  - — provides data interface
- card type S/T
  - — supports a remote system or PBX located on the customer premise
- card type U
  - — connects to standard ISDN two-wire outside plant

  Note: Card types U and S/T can be mixed within a line subgroup.

Line concentrating module enhanced line card distribution

The LCME has 480 line card slots available for a combination of line cards and circuit applications.

The following list shows a sample provisioning:

- 480 ISDN U-type line cards
- 240 ISDN S/T-type line cards
- 480 P-phone business set line cards
- 240 Datapath data lines
- 208 Datapath alternate mark inversion (AMI) lines
- 1 Datapath integrated bit error rate test (IBERT) line
- 480 POTS A-type line cards

- 472 POTS message waiting lines

  Note: The LCME does not support POTS B-type line cards (NT6X18AA/AB).

The following table lists the names and the product engineering code (PEC) for the line cards that can be provisioned for the LCME.

LCME cards and product engineering codes (PEC)

Card name	PEC
ISDN 2B1Q U-line card	NTBX27AA
ISDN S/T line card	NTBX26AA
Datapath line card	NT6X76AA, NT6X71AB, NT6X76AC
IBERT (for ISDN and Datapath testing)	NT6X99AA
POTS and EBS line cards	NT6X17AA, NT6X17AB, NT6X17AC, NT6X18AA, NT6X18AB, NT6X19AA, NT6X20AA, NT6X21AA, NT6X21AB, NT6X21AC
Ringing generator card (for POTS)	NT6X30AA
PUPS card	NTBX71AA
Bus interface cards (BIC)	NTBX36BA
Digroup controller cards (DDC)	NTBX35AA
LCME processor card	NTBX34BA
Power converter 0	NTBX72AA
Power converter 1	NT6X53CA
Filler plate for unequipped line drawers	NT6X05AX

Trunk modules

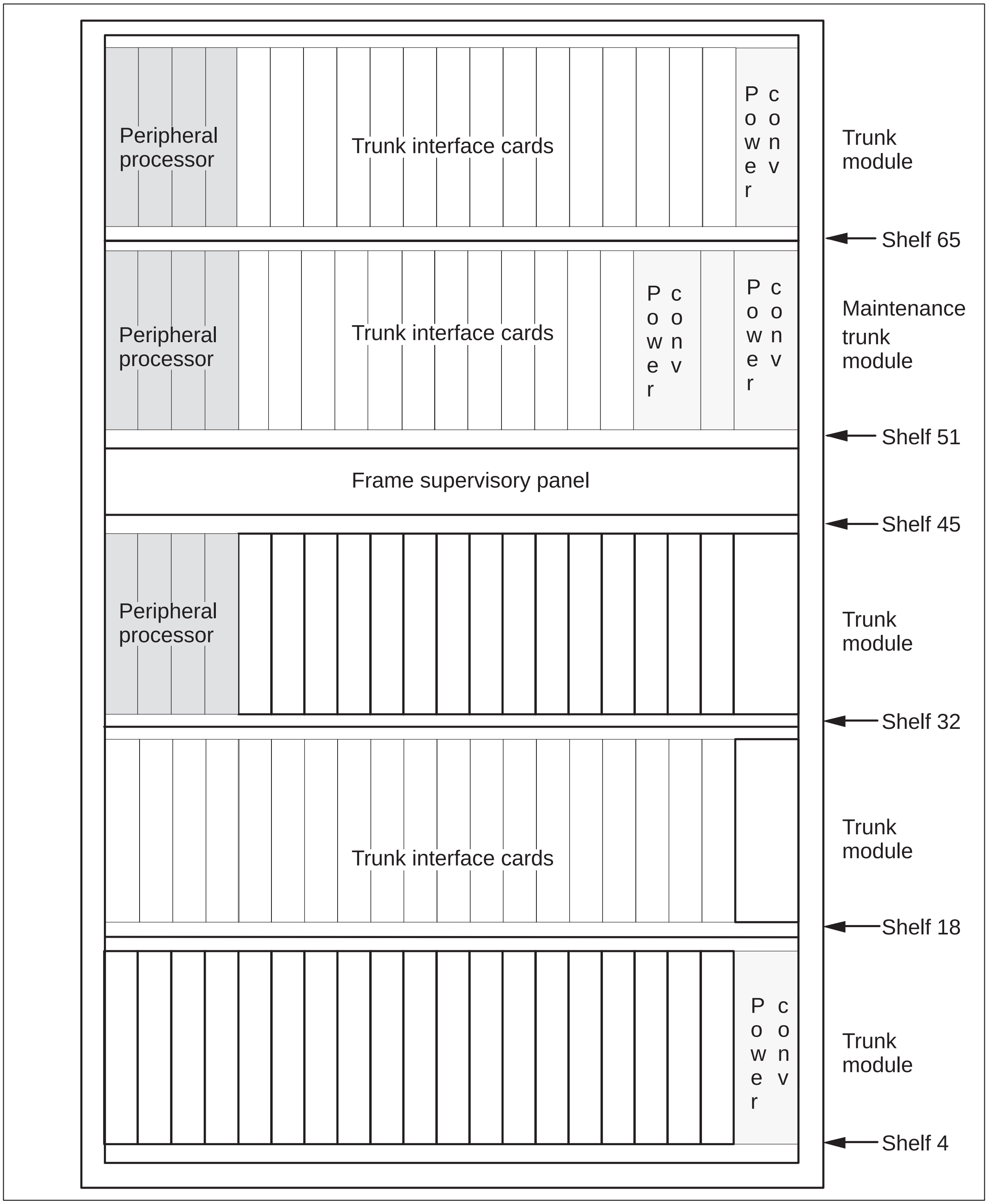
The trunk module (TM) provides the interface between the analog trunks and the DMS digital switching network. The TM accommodates service circuits and performs digit control and distribution tasks. A TM can interface up to 30 analog trunks with a 2.56-Mb/s speech link to the network. Because the TM connects to one speech link (30 channels), there is no concentration and no blocking.

The TM also handles service circuits, such as MF receivers and announcement trunks. Refer to the following figure for an example of a trunk module equipment frame.

Physical layout

Each TM is contained in a single equipment shelf and uses one speech link to connect to the network. Each TM can accommodate a maximum of 15 analog trunk cards and can handle up to 30 circuits. There are a maximum of five TMs in an equipment bay.

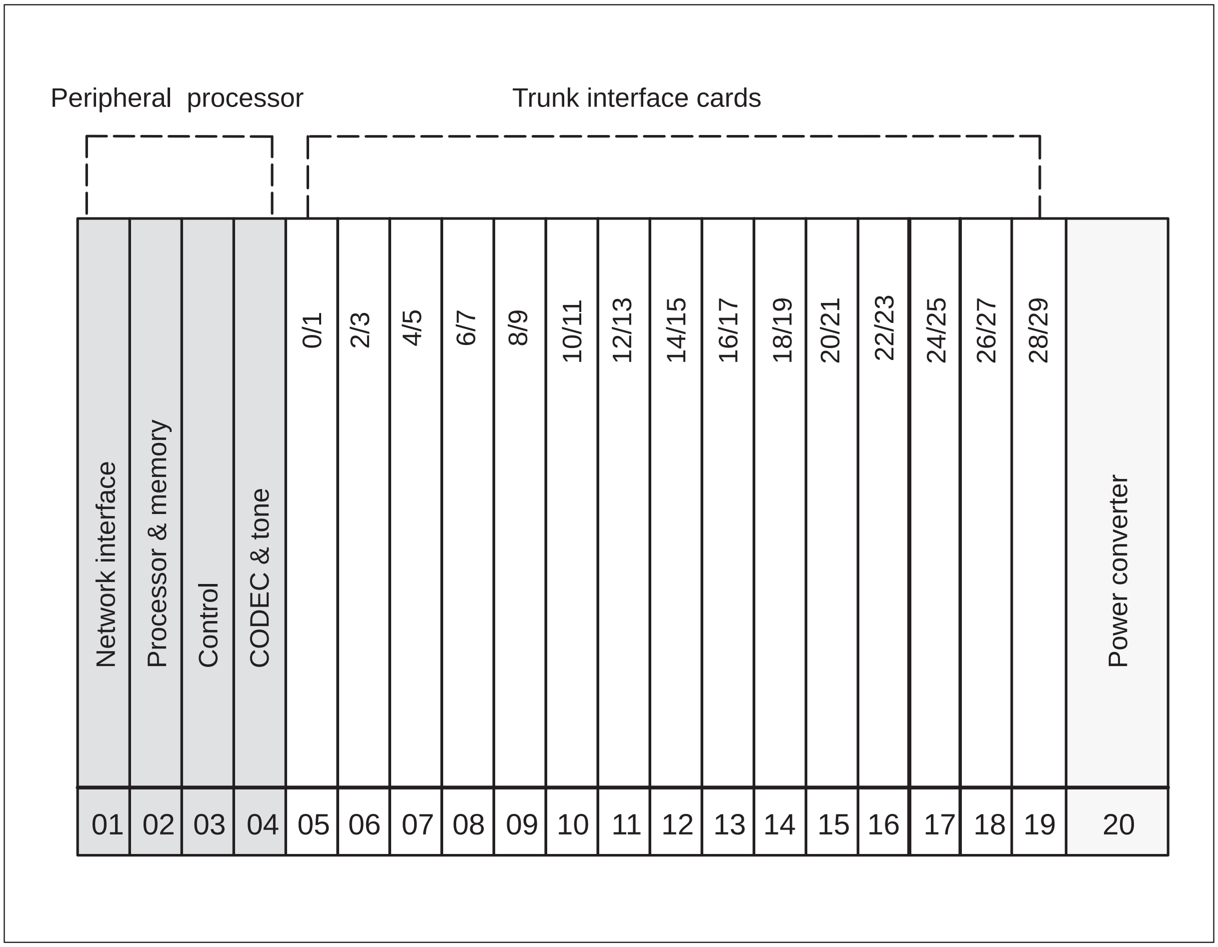
Trunk module equipment frame



The abbreviation TM and the name trunk module are general terms used to represent the following: TM2, TM4, TM8, and maintenance trunk module (MTM). Interface cards are packaged as printed circuit cards that plug into the modules. One card may contain more than one circuit.

The first four card positions are assigned as the common control cards. These four cards are known collectively as the peripheral processor for the TM. The following figure shows a typical TM shelf layout.

Trunk module shelf



The type of TM used is dictated by the TM-to-distribution frame (DF) cabling arrangement:

- Trunk module two-wire (TM2)
- Trunk module four-wire (TM4)
- Trunk module eight-wire (TM8)

- International trunk module 8-wire (ITM8)

Trunk group assignments

The trunk group assignment is performed by the operating company. Assignments for digital and analog trunks are performed independently even if a trunk group contains a mixture of the two types.

Analog trunk considerations

The smallest trunk group should be assigned first and the largest trunk group last. This process ensures a good spread for the smaller trunk groups. The recommendation is to assign half of the trunk group to A-powered TMs and the other half to B-powered TMs. With small trunk groups, one trunk from each group should be assigned to as many TMs as possible.

Digital trunk considerations

The DCM assignment is performed by NT during the hardware provisioning process and is listed on the D620 form. The DCM has five circuit cards and each card is connected to a separate carrier system.

Each carrier system has 24 trunks usually comprising one trunk group. The assignment procedure involves entering the common language location identifier (CLLI) code of each trunk in the trunk group.

If the trunk group is larger than 24 trunks, it spans more than one DCM circuit and will require more than one DCM card. For increased reliability, assign one third of each trunk group to each DCM card.

Digital carrier module cards

Each DCM card is assigned to the four network ports in a fixed cross-connect pattern. The 24 time slots are divided into four sub-groups, as shown in the following table.

Subgroup time slots

Subgroup	Time slots
A	1, 5, 9, 13, 17, 21
B	2, 6, 10, 14, 18, 22
C	3, 7, 11, 15, 19, 23
D	4, 8, 12, 16, 20, 24

The hardware assignment process ensures that the four ports are assigned to different subgroups. If a DCM card is assigned to only one trunk group, it is evenly distributed over four ports.

Analog trunks to trunk module

- Cards that only operate with a particular type of trunk module (TM), fixed cards, are assigned first.
- Cards that operate with more than one type of TM are assigned after all the fixed cards are assigned.
- The trunk card types are assigned in order of quantity, from smallest to largest. For example, assign the three TM2 cards before assigning the four TM8 cards.
- Vacant card positions are spread evenly across all TMs. Future expansions can be handled by adding plug-provisional (PIP) cards in vacant positions. This leaves existing card assignments unaffected.
- For reliability, two cards are assigned for each trunk group, with each card located in a separate TM.
- Service circuits, such as, announcement circuits, coin control circuits, tone circuits, and conference circuits should be limited to 80 percent occupancy.

Digital trunks to digital carrier module

- The digital carrier module (DCM) requires only one type of line card for all types of carrier systems, such as, DE2 or DE3.
- A DCM accommodates a maximum of five line cards.
- For a DCM with only one carrier circuit, the assignment can be made to any line card on any DCM.
- When more than one carrier circuit is in use, circuits should be assigned to line cards in as many DCMs and digital carrier equipment (DCE) frames as possible.

Using OMs to evaluate load balance performance

Administration data

This chapter provides a description of the OM groups and registers used in loading administration and information to assist the administrator in collecting performance information. Each table gives the OM group, the register designation, BCS history, associated registers and register validation (if any), and a brief description of each register. Many registers are not associated with other registers, so there is no validation procedure other than testing the individual register for scoring accuracy.

OMs used to evaluate load balance performance

Group	Register	Information
DTSRPM		Description: Dial tone speed recording on a peripheral module basis BCS history: This group was created in BCS24.
	DGTDLY	Description: Total number of Digitone calls having 3-second delay. BCS history: This register was created in BCS24 Associated registers: None Register validation: None

—continued—

OMs used to evaluate load balance performance (continued)

Group	Register	Information
	DGTTOT	Description: Total number of calls made on Digitone lines. BCS history: This register was created in BCS24 Associated registers: None Register validation: None
	DPLDLY	Description: Total number of dial pulse calls delayed. BCS history: This register was created in BCS24. Associated registers: None Register validation: None
	DPLTOT	Description: Total number of dial pulse calls. BCS history: This register was created in BCS24. Associated registers: None Register validation: None
	KSDLY	Description: Total number of key set calls with 3-second delay. BCS history: This register was created in BCS24. Associated registers: None Register validation: None
	KSTOT	Description: The number of calls from key-set lines BCS history: This register was created in BCS24. Associated registers: None Register validation: None
LINAC		Description: Line access measurements BCS history: This group was created in BCS28.

—continued—

OMs used to evaluate load balance performance (continued)

Group	Register	Information
	LINABAN	Description: Total number of calls in an LCM that are abandoned before dial tone is received. BCS history: This register was created in BCS28. Associated registers: None Register validation: None
	LINCAT	Description: Total number of call attempts in an LCM. BCS history: This register was created in BCS28. Associated registers: None Register validation: None
	LINCATF	Description: Line call attempt failures BCS history: This register was created in BCS28. Associated registers: None Register validation: None
	LINTDEL	Description: Line access dial tone delay BCS history: This register was created in BCS28. Associated registers: None Register validation: None
LMD		Description: Line traffic BCS history: This group was created prior to BCS20.
	LMTRU	Description: Total number of lines that are in the line_cp_busy state. BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None

—continued—

OMs used to evaluate load balance performance (continued)

Group	Register	Information
	MADNATT	Description: Total number of pegs for the associated LCM for each secondary member of a multiple appearance directory number (MADN) group (except non-ringing secondary members). BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	NORIGATT	Description: Total number of originating call attempts reported by the line module to the CC. BCS history: This register was created prior to BCS28. Associated registers: OFZ_NORIG Register validation: OFZ_NORIG counts originating call attempts that are recognized by the central control. The relationship between LMD_NORIGATT and OFZ_NORIG is: The sum of LMD_NORIGATT= (65536 * OFZ_NORIG2) + OFZ_NORIG line modules
	NTERMATT	Description: Total number of attempts to find an available speech link from the network to the terminating line. BCS history: This register was created prior to BCS20. Associated registers: OFZ_TRMNWAT counts attempts to find a speech path to a terminating line Register validation: The relationship between LMD_NTERMATT and OFZ_NTRMNWAT is: The sum of LMD_NTERMATT= (65536 * OFZ_TRMNWAT2) + OFZ_TRMNWAT line modules

—continued—

OMs used to evaluate load balance performance (continued)

Group	Register	Information
	ORIGBLK	Description: Originating blockage BCS history: This register was created prior to BCS20. Associated registers: LMD_NORIGATT Register validation: The sum of LMD_ORIGBLK = OFZ_ORIGLKT line modules
	ORIGFAIL	Description: Originating attempt failures BCS history: This register was created prior to BCS20. Associated registers: TRMTCM_TCMPSIG, TRMTCM_TCMPDIL, TRMTER_TERRODR Register validation: None
	PERCLFL	Description: Terminating call attempt failures BCS history: This register was created prior to BCS20. Associated registers: TRMTER_TERSYFL Register validation: None
	REVERT	Description: Revertive call attempts BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	TERMBLK	Description: Terminating blockage BCS history: This register was created prior to BCS20. Associated registers: OFZ_TRMBLK Register validation: The sum of LMD_TERMBLK = OFZ_TRMBLK line modules

—continued—

OMs used to evaluate load balance performance (continued)

Group	Register	Information
PMMSGCNT		Description: Peripheral module message counter BCS history: This register was created in BCS29.
	DNACK	Description: Double negative acknowledgements BCS history: This register was created in BCS29. Associated registers: None Register validation: None
	IDLSTATE	Description: Spurious frame interrupts BCS history: This register was created in BCS29. Associated registers: None Register validation: None
	IINVBYTE	Description: Invalid byte BCS history: This register was created in BCS29. Associated registers: None Register validation: None
	IINVCHAR	Description: Invalid character BCS history: This register was created in BCS29. Associated registers: None Register validation: None
	IINVCKSM	Description: Invalid checksum BCS history: This register was created in BCS290. Associated registers: None Register validation: None

—continued—

OMs used to evaluate load balance performance (continued)

Group	Register	Information
	IINVMSG	Description: Invalid message BCS history: This register was created in BCS29. Associated registers: None Register validation: None
	INACK	Description: Interunit communications link negative acknowledgments BCS history: This register was created in BCS29. Associated registers: None Register validation: None
	INVNODE	Description: Invalid node BCS history: This register was created in BCS29. Associated registers: None Register validation: None
	NULLMSG	Description: Null messages BCS history: This register was created in BCS29. Associated registers: None Register validation: None
	PMCRC	Description: Incorrect cyclic redundancy check BCS history: This register was created in BCS29. Associated registers: None Register validation: None

—continued—

OMs used to evaluate load balance performance (continued)

Group	Register	Information
	PMNACK	Description: Single negative acknowledgement BCS history: This register was created in BCS29. Associated registers: None Register validation: None
	PMOVFL	Description: Byte overflow BCS history: This register was created in BCS29. Associated registers: None Register validation: None
	RCVDSUCC	Description: Successfully received messages BCS history: This register was created in BCS29. Associated registers: None Register validation: None
	WFACK	Description: Wait-for-acknowledgement timeout BCS history: This register was created in BCS29. Associated registers: None Register validation: None
	WFMSG	Description: Wait-for-start-of-message timeouts BCS history: This register was created in BCS29. Associated registers: None Register validation: None

—continued—

OMs used to evaluate load balance performance (continued)

Group	Register	Information
	WFNR	Description: Wait-for-idle message BCS history: This register was created in BCS29. Associated registers: None Register validation: None
	WFNX	Description: Wait-for-link idle BCS history: This register was created in BCS29. Associated registers: None Register validation: None
	WFSND	Description: Wait-for-send timeout BCS history: This register was created in BCS29. Associated registers: None Register validation: None
	XMITSUCC	Description: Successfully transmitted messages BCS history: This register was created in BCS29. Associated registers: None Register validation: None

—end—

SITE OM group

Group	Register	Description
SITE		Description: Traffic and dial tone speed recording, remote sites BCS history: This register was created prior to BCS20.
	DLMKS_D	Description: Digital line module key driven set delay BCS history: This register was created in BCS20. Associated registers: None Register validation: None
	DLMKS_T	Description: Digital line module key driven set total BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	DPDELAY	Description: Dial pulse delay BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	DPTESTC	Description: Dial pulse test calls BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	DTDELAY	Description: Digitone delay BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None

—continued—

SITE OM group (continued)

Group	Register	Description
	DTTESTC	Description: Digitone test calls BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	INRTERM	Description: Incoming routed to terminating BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	INTERSIT	Description: Intersite BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	INTRASIT	Description: Intrasite BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	LCMDP_D	Description: Line concentrating module dial pulse delay BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None

—continued—

SITE OM group (continued)

Group	Register	Description
	LCMDP_T	Description: Line concentrating module dial pulse total BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	LCMDT_D	Description: Line concentrating module Digitone delay BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	LCMDT_T	Description: Line concentrating module Digitone total BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	LCMKS_D	Description: Line concentrating module key-driven set delay BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	LCMKS_T	Description: Line concentrating module key-driven set total BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None

—continued—

SITE OM group (continued)

Group	Register	Description
	LMDP_D	Description: Line module dial pulse delay BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	LMDP_T	Description: Line module dial pulse total BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	LMDT_D	Description: Line module Digitone delay BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	LMDT_T	Description: Line module Digitone total BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	RCTDP_D	Description: Remote concentrating terminal dial pulse delay BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None

—continued—

SITE OM group (continued)

Group	Register	Description
	RCTDP_T	Description: Remote concentrating terminal dial pulse total BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	RCTDT_D	Description: Remote concentrating terminal Digitone delay BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	RCTDT_T	Description: Remote concentrating terminal Digitone total BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	RORIGOUT	Description: Remote originating to outgoing BCS history: This register was created prior to BCS20. Associated registers: None Register validation: None
	—end—	

Analyzing data

Analyzing load information

The OM information associated with conditions that have produced higher than expected loads or overloads requires evaluation and analysis of operational measurements, maintenance logs, PM Activity logs, and customer service trouble reports. If the load point is above the busy season high day value used to engineer the switch, investigations should be completed to determine if this was a typical or an abnormal occurrence.

As the load on the switch increases, there may be an increase in the delay times. In a high load or overload condition, additional origination attempts result in increased dial tone delay. The load condition levels are identified as normal load, high load, and overload.

A certain level of blockage is engineered into DMS-100 office applications. Due to concentration, line terminations have a higher blockage probability than trunks. Because trunk peripherals have no concentration, they are nonblocking. Trunks can contribute to blocking in traffic sensitive components (other than the trunk PMs) when the overall load (line traffic and trunk traffic) exceeds the capacity of the switch.

Using operational measurements

Dial tone delay caused by a shortage of receivers or a PM type can be determined from the operational measurements (OMs). The LMD and PMOVLD OM groups measure the individual PM that may cause dial tone delay due to traffic usage or attempt overloads. Dial tone delay measurements on a PM basis help identify individual PMs that may be overloaded.

The RCVR and UTR OM groups indicate the level of receiver traffic and are used to determine if an insufficient number of receivers is causing dial tone delays. The OM groups that monitor dial tone delays are DTSR, SITE, SITE2, LMD, PMOVLD, UTR, RCVR, LM, PMTYP, PM, and PM2.

The DTSR OM group monitors the level of dial tone delays encountered in the system and designates the type of PM and signaling system that encounter the delay (line module (LM) or line concentrating module (LCM)

and dial pulse (DP) or dual tone (DT). Dial tone delays are monitored by an OM group on an individual PM basis.

Delay measurements

- Dial tone delay (DTD) and incoming start dial delay measurements can be used to measure the level of service offered to originating traffic. Dial tone delays and incoming start dial delays may occur under any of the following conditions:
- the central processing unit (CPU) is busy
- the peripheral has no channels available
- the peripheral processor is busy
- a receiver cannot be attached

Prior to establishing a network path, the dial tone delay or incoming start dial delay criteria apply to the call attempt. Once the call attempt seizure has been satisfied and the called number information has been processed, the switch attempts to establish a network path to the idle terminating line or trunk.

When dial tone or start dial requirements are satisfied, the DMS-100 central control (CC) treats line and trunk originations equally. The causes of any delays can be established by monitoring OMs and log reports.

A dial tone speed recorder (DTSR) provides information which can be used to calculate percent DTD. If the DTD calculations fall within the objective GOS guidelines, there is a possibility that there was a high load but not an overload. This information is available on an individual PM basis.

Start dial delay

For incoming start dial delays, the ISDD OM group is used. The measurement for incoming start dial delays provides the level of delays on a individual PM basis. A relative indication of incoming start dial delays due to the central control can be obtained from the ACTIVITY measurement of the OAVGDEL OM group at the MAP (maintenance and administration position).

The TRK OM group identifies the traffic for individual trunk groups. Operational performance must also be considered for incoming start dial delay. The DCM, TM, PMTYPE, PM, and PM2 OM group measurements are used to identify equipment issues. Blocking of calls is measured by matching loss measurements.

Matching loss

In the DMS-100 family, terminating matching loss is defined as the failure to set-up a connection from the network to an idle line. Outgoing matching loss occurs when a path cannot be found to connect a line to an idle outgoing trunk. Tandem matching loss is defined as the failure to establish a connection from a trunk to an idle trunk.

These occurrences are measured by two conditions:

- If the blockage occurs in the network, the TRMT1_NBLH (TRMTRS_TRSNBLH) register is pegged. The TS OM group is then used to determine which network is at or over capacity.
- If the blockage occurs in the peripheral module, the TRMT1_NBLN (TRMTRS_TRSNBLN) register is pegged.

The OM register LMD_TERMBLK is then used to determine which line peripheral contributes to blockage. Do not exceed the engineered software parameters for data store and program store in the DMS-100. Exceeding software parameters can result in unsatisfactory grade of service. For example, a lack of CPLETTERS or call connecting blocks (CCB) can result in no dial tone for the subscriber.

The lack of these resources is measured in the CP OM group by the registers CPLOOVFL and CCBOVFL. If some of the engineered parameters are exceeded, activation of a feature may be prevented.

The lack of call waiting extension blocks prevents a call from being attached to a busy line that has the call waiting feature. This failure is measured through the OM register EXT_NO_OF_CWT_EXT_BLKS_EXTOVFL. If an OFCSTD or OFCENG parameter is exceeded and is affecting the call completion or feature activation, the overflow registers in the EXT and CP OM groups are pegged.

> ***Note 1:*** Refer to *Office Parameters Reference Manual* for the proper provisioning information.
>
> ***Note 2:*** Refer to *Operational Measurements Reference Manual* for detailed OM group and register descriptions.

High load and overload operational measurements

Register overflows indicate a higher than normal load being handled by the processors. The OMs associated with the overflows should be investigated. If there are no overflows, the traffic load is probably not the issue.

The OMs for determining high load and overload are as follows:

- PMOVLD—The registers in this OM field are PORGDENY and PTRMDENY. Numbers in these fields indicate that calls are being denied due to overload. Each peripheral in the switch which is denying calls will be noted (for example, LCM, LGC, LTC, DTC, and RCC).
- LMD—This OM provides the calls originating and terminating to the LCMs associated with the controllers. The information obtained from this report is useful in calculating the real-time utilization.

There is no OM for call attempts on the digital trunk controller (DTC). Averaging techniques using the registers in the OFZ OM field have to be used to determine the average call rate per DTC (the total trunk call attempts divided by the operational DTCs equates to the number of attempts for each DTC).

Maintenance activities

Maintenance logs provide an indication that the processor has experienced an overload condition. The “ \ ” symbol indicates a change of service state from in service (InSv) to in service trouble (ISTb). At this point, the activities associated with the node ISTb should be closely monitored and fully investigated. The PM activity and performance tool can be used to monitor the operational state of the peripheral processors.

The capacity power utilized by the processors in operation is clearly defined. Each of the the two processors has its own maximum call processing point. The master processor is engineered for a maximum call processing occupancy rate of 80%, while the signal processor maximum is 90%.

If the call processing occupancy rate is between 0% and the maximum for the processor, the operating conditions are within the normal engineered range. If the indications are between the maximum and 99%, the processors are handling higher than normal call attempt or maintenance activity load. When the processor is utilizing 100% for call processing, it is in an overloaded state.

Some maintenance activities have priority over call processing. If the processor is engaged in evaluating its performance, call processing will suffer. It is important that all processors are operating properly at all times.

Service trouble reports are used to identify high load or overload conditions. Numerous reports from a single node would indicate a focused problem. Certain indications, such as slow dial tone, no dial tone, incomplete calls, and cutoffs are reports which can be associated with overload conditions.

The line module (LM), remote line module (RLM), and digital carrier module (DCM) are traffic usage limited. These modules do not require in-depth analysis for determining real time capacity. Overload control for the LM, RLM, and DCM is provided when the call attempts are higher than anticipated.

Babbling lines

A babbling line is a line that sends messages at a high rate (operating in a loop) toward the controller. To avoid overloading the controller and to stop further messages, it is necessary to detect and remove these lines from service. The detection and disabling of messages is performed in the LCM with overall control by the CC.

The LCM detection code performs measurements on one line at a time. Different checks are performed for plain ordinary telephone service (POTS) lines than for intelligent (business sets or data unit) lines due to the difference in the characteristics of the messages. When a line is identified as a ‘‘babbler,’’ a report is sent to the CC through the controller. The CC then generates the associated log message and removes the line from service.

The incoming message overload line handler feature provides the means to return temporary babblers to service. Excessive key hits on the electronic business set can cause the LCM to recognize the set as a ‘‘babbler.’’ The LCM informs the CC to operate the cutoff relay on the business set and put it out of service. Trunk call attempts that have very short off-hooks are not reported to call processing.

Actions to be taken

When a log report is printed showing the state change from InSv to ISTb, all activity (either by the technician or by hardware failures on the switch) on the peripheral module should be recorded. The OMs for the period when the overload occurred should be recorded with the information obtained about other activity on the peripheral and its P-side nodes. Attempts should be made to determine if the state change is due to under provisioning or is a result of maintenance-related problems.

Network management controls

Network management controls are typically used to limit or alter traffic for purposes of ensuring maximum traffic throughput during adverse or overload conditions. Network management controls are not expected to replace internal overload controls. They are used as a supplementary tool to enhance the throughput of the switch and the network completion of traffic.

The key considerations for implementation of network management controls for an unexpected traffic overload are as follows:

- the source of the overload
- the impact on the throughput and the grade of service (GOS)
- the network control to be used
- the benefit to the network when the control is implemented

The grade of service or call completion characteristics of the traffic should be used as a basis for the decision to use network management controls in any situation. Preplanned network management strategies can be used to minimize the effects of high loads caused by unexpected traffic situations that may occur.

Incoming trunk busy

Incoming trunks busy (ITB) restricts incoming traffic by removing incoming trunks from service. By manually applying this control to specific trunk groups, a percentage of the trunks are made busy. This control should be applied to the trunk groups that are using the call processing resources and affecting the grade of service of the PM or CC.

Selective incoming load control

Selective incoming load control (SILC) restricts incoming traffic by routing calls within a preset gap, or a percentage of the calls, to a tone of 120 impulses per minute (IPM). For selected trunk groups, this control can be activated automatically or manually to route set levels of incoming traffic.

The SILC control allows a predefined percentage of the traffic to be completed. It can also be used to establish a timing gap between the calls that will be completed.

Line load control

Line load control (LLC) restricts line traffic by routing lines (other than essential service classed lines) to lockout. This control can only be implemented manually. For this control, the initial request for service is recognized by the call processing resources, and the CC determines if the line is an essential line.

Essential service protection

Essential service protection (ESP) provides certain users with a preferential grade of service. The specific users are identified by an essential line number (ELN) option established for their particular line(s).

This control can only be activated manually. When the control is activated, the essential lines are placed at the head of the origination queue and are given preference over other lines for dial tone.

Planning and engineering

Software integration for the DMS-100 Wireless switch supports both wireline and wireless applications using the same hardware components. This integration allows wireless and wireline subscribers to share signaling links and interswitch trunks. To upgrade from a Nortel (Northern Telecom) wireline switch, the DMS-100 Wireless switch requires only two additional cabinets and the radio subsystem.

Required hardware

The DMS-100 Wireless switch uses existing wireline equipment. This switch requires the following hardware to support wireless calls:

- Fiberized link interface shelf (FLIS) or link peripheral processor (LPP) cabinet is equipped with code division multiple access (CDMA) interface units (CIU) and CDMA application units (CAU). These units provide an interface to enable wireless messages between the switch and the radio access subsystem. Wireless messages include those associated with mobile phone call setup, registration, and intersystem handoff.
- Digital trunk controllers (DTC) provide voice trunks between the wireless and radio systems, and trunking to the public switched telephone network (PSTN) or wireless network.
- Base station controller (BSC) provides CDMA voice coding, intra-system handoff, and advanced power control. It is collocated with the DMS-100 Wireless system.
- Base station transceiver subsystem (BTS) consists of cell site equipment that provides the air interface between the mobile (or wireless) phones and the cell site. Each BTS covers a separate area. They are collocated with the antenna towers; the combination is called a cell site.
- Series 60 processor is the baseline processor required for DMS-100 Wireless systems. (Larger wireless systems require the series 70 extended memory processor.)

Note: Refer to section “Hardware descriptions” in this chapter for details on these hardware components.

CCS7 network interfaces

The DMS-100 Wireless switch provides integrated Common Channel Signaling 7 (CCS7) messaging so that wireline and wireless messages can use the same CCS7 links. If a CCS7 link exists between the switch and a serving signaling transfer point (STP), migration to the DMS-100 Wireless system requires no additional links if the total messaging traffic does not exceed the existing link's physical messaging throughput.

External trunks and call routing

The DMS-100 Wireless switch uses analog or digital trunks to link public and private wireline or wireless (or both) networks. External digital trunks connect with the DMS-100 Wireless switch through circuit packs mounted in either a DTC, a line trunk controller (LTC), or a remote switching center (RSC). Analog trunks interface through circuit packs mounted in an 8-wire trunk module (TM8).

CDMA radio subsystem

The DMS-100 Wireless switch connects to the CDMA radio subsystem. Nortel's CDMA radio subsystem includes cell site equipment that operates at the 800-MHz (cellular) and 1900-MHz personal communication service (PCS) frequencies.

The CDMA radio subsystem includes the following BTS options:

- outdoor 1900 MHz—an outdoor enclosure that contains DC rectifiers, T1 backhaul interfaces and battery backup
- indoor 1900 MHz—an indoor version of the outdoor unit
- indoor 800 MHz—an indoor, 800-MHz, "macro" version of the 1900-MHz model integrated into an existing cellular system

All units comply with technical standards IS-95A (800 MHz), ANSI J-STD-008 (1900 MHz), and other applicable CDMA specifications.

Technical specifications

Generic network PCS overview

There are three major subsystems in a wireless PCS network:

- radio
- switching
- mobility database

The following sections describe the functions of each major subsystem in the DMS-100 Wireless switch.

Radio subsystem

The radio subsystem consists of the following network elements related to the control and management of radio resources:

- The BSCs control the message and signaling routing between itself, the switch, and the BTS subsystem.
- The BTSs link the mobile handsets and the BSC.
- Mobile handsets include equipment by which the end user communicates to the BTS through radio channels.

The radio subsystem provides operations, maintenance, testing, and accounting management capabilities.

The radio subsystem can also have a local database, or visitor location register (VLR), to manage roaming (or visiting) mobile end user information. This information is called profile information.

The home location register (HLR) is the permanent database that stores profile information about a mobile end user. The VLR retrieves profile information from the HLR when a mobile end user moves into the switch's territory. The switch checks the serving VLR for the profile information. If the switch finds the information in the serving VLR, the call proceeds. If the switch does not find the profile information, its sends a profile request message to the mobile unit's HLR. When the HLR responds with the information, the switch stores it in the serving VLR and then the call proceeds.

Note: The DMS-100 Wireless switch support internal VLRs only.

The BSC, which interfaces directly with the switching subsystem, connects to a number of BTSs. These BTSs provide protocol conversion for communication between the mobile handsets and the BSC.

The DMS-100 Wireless switch uses the CDMA radio technology.

Switching subsystem

The switching subsystem performs the following wireless functions:

- routes calls between mobile handsets, or between a mobile handset and the PSTN
- routes incoming calls to a wireless PCS end user. The switching subsystem queries the location tracking database(s) and redirects the calls to the end user's present location.

- receives outgoing calls for delivery to the called party
- provides the connection to the PSTN, inter-exchange carrier (IEC), North American cellular network (NACN), and other networks to allow wireless end users to communicate with other telephone end users throughout the world.

Mobility database subsystem

The mobility database subsystem manages end user and terminal (PCS handset) information. This information includes service profile, accounting information, and authentication. The mobility database subsystem also provides operations, maintenance, and accounting management capabilities.

The mobility databases that handle calls to and from the mobile PCS end users include:

- an HLR that provides
  - — a permanent repository for an end user’s terminal service profile (TSP)
  - — the terminal location tracking at VLR granularity
  - — support and management of the end user’s service profile
  - — service validation (for example, credit check and lost terminals)
  - — accounting management capabilities
- a VLR that provides
  - — assistance in terminal registration
  - — current terminal location and tracking
  - — temporary storage of the TSP
- an access manager (AM) that allows for
  - — radio system management
  - — assistance in terminal registration
  - — routing number assignment for call delivery
  - — terminal authentication

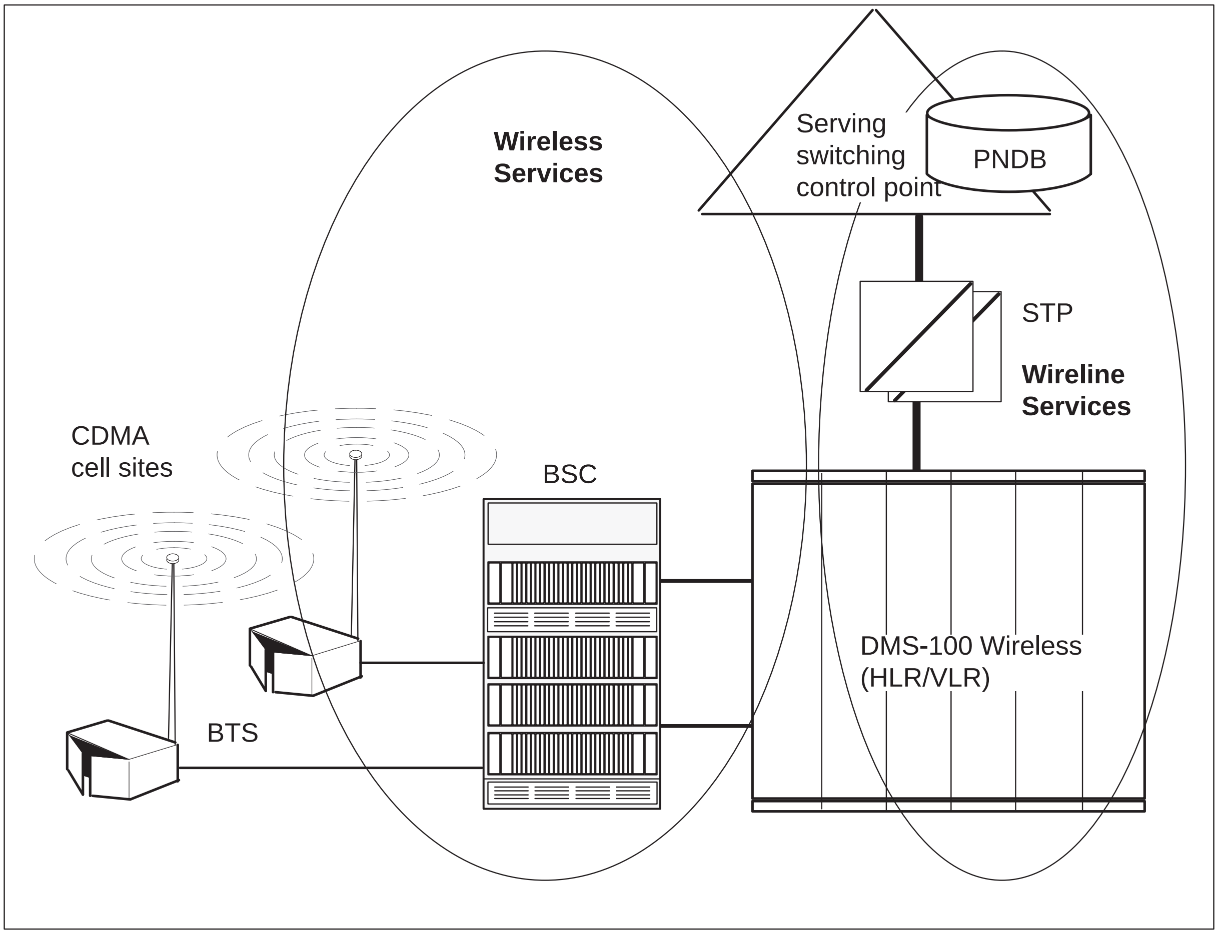
Phased network configurations

Switch architecture

The DMS-100 Wireless switch uses DMS technology to deliver wireless and wireline services. Nortel has integrated compatible wireless software with wireline switch software, so that both applications reside and operate on a single DMS SuperNode platform.

The following figure shows an example of how the DMS-100 Wireless switch resides on a DMS SuperNode platform.

DMS-100 Wireless switching platform



Consolidation of the wireline and the wireless functionalities in the DMS-100 Wireless switch adds the following benefits:

- an integrated HLR/VLR function (Support for external HLRs also exists.)
- wireless mobility air interfaces (CDMA)

The hardware added to upgrade an existing wireline switch with wireless functionality includes

- additional DTCs to support integrated service links for communication between the switch and the wireless functions
- added LPP or FLIS platform, and additional DTC support to terminate signaling and voice traffic from the radio environment to the switch
- a core processor upgrade to either a series-60 or series 70EM processor to address the real-time capacity requirements of this integrated load

Engineering considerations

Data assignment

Table control is the collection of software and commands necessary to enter, display, and change configuration databases. These databases, also known as datafill tables, include the customer database (the HLR), translations and routing tables, hardware equipment properties, network connectivity, cell site definition and interactions, and system operating parameters.

Note: The computing module (CM) stores two sets of translations tables, one for wireline and one for wireless call processing.

No software exists to exchange configuration data between the CM and the base station manager (BSM). (The BSM provides a graphic user interface [GUI] for operations, administration, and maintenance of the BSC and the BTS.) Both sides require datafill configuration data (such as where the selector bank subsystems [SBS] are, or what cells are sectored, on both systems).

“Static data” is the configuration data and operating parameters that the switch downloads to its peripherals from the CM. When operating company personnel bring the switch from an out-of-service state, the switch downloads static data to its peripherals. This download is called bulk static data because the peripherals receive the whole static data load.

After operating company personnel make table control changes, the peripheral receives a dynamic static data update (providing the peripheral is in service). The update includes only the tuple for the changed data.

Office parameters

The DMS-100 Wireless switch includes both wireline and wireless office parameters. This includes an office parameter, for equal access (EA). Refer to chapter 10, “Equal access and trunking,” for more information on this EA office parameter.

Installation considerations

Installation tools

Use the automatic board-to-board testing tool when the DMS-100 Wireless switch receives lines from a wireline office. Use the pretest and cut-over testing tool when the Loading switch receives trunks from an existing office.

Refer to Northern Telecom publication (NTP) *Automatic Board-to-Board Testing*, 297-1001-522, for additional information on board-to-board testing.

BSC/BSM and BSM placement

The BSC (central office equipment) and BTS (cell site equipment) use standard C28 cabinets. Make sure that all test locations are accessible and are not concealed behind door panels that would require tools for equipment removal.

The customer determines placement of the BSM. Note that BSM monitors are larger than MAP terminals and do not always fit on standard office furniture.

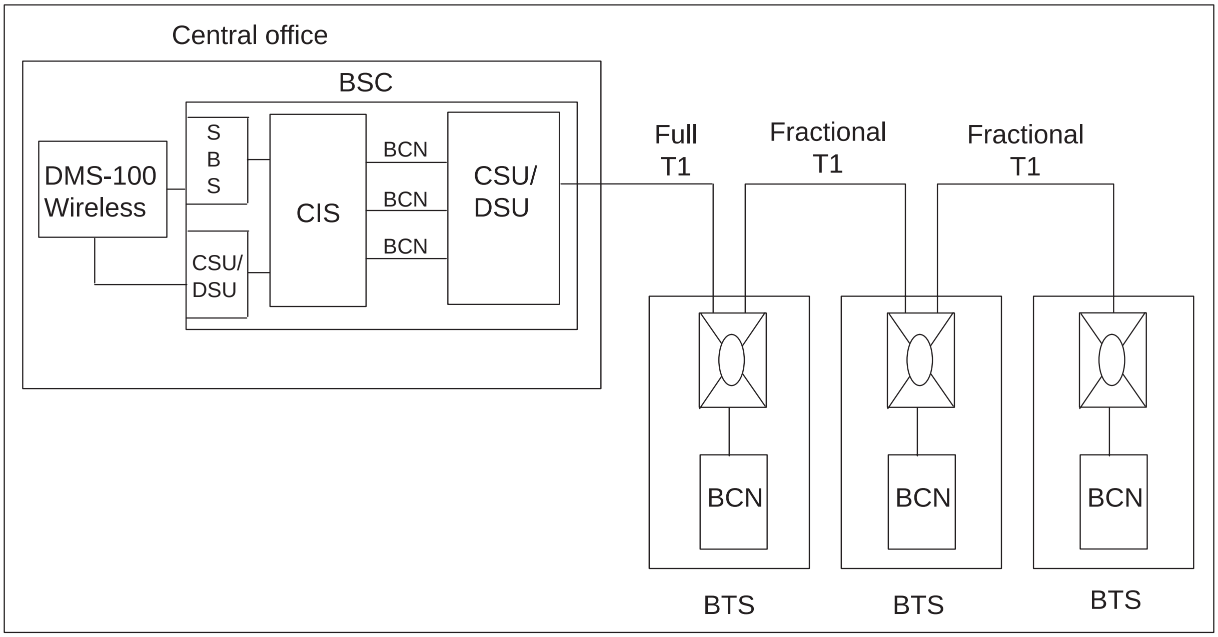
BTS installation

Several configurations exist for using fractional T1 links.

Note: The Loading switch requires separate T1 links for connecting a BSC. (This requirement applies even if the BSC is physically collocated with a cell site.)

The following figure shows an example of a “daisy-chained BTS.”

Daisy-chained BTS



In some configurations, you can daisy-chain several CDMA cell sites. The first T1 interface is a full T1 link, divided into three groups of channels. Each channel group associates with one base station communications network (BCN) interface. The second T1 interface is fractional, and contains two groups of channels. The third T1 interface is also fractional, and contains one channel group.

Note: Remember that you cannot easily change the channel groups after installation.

Grounding

Equipment ground for the central office (CO) frames follows Nortel practices, described in NTP 297-1001-156, *DMS-100 Power Distribution-Grounding Guide.*

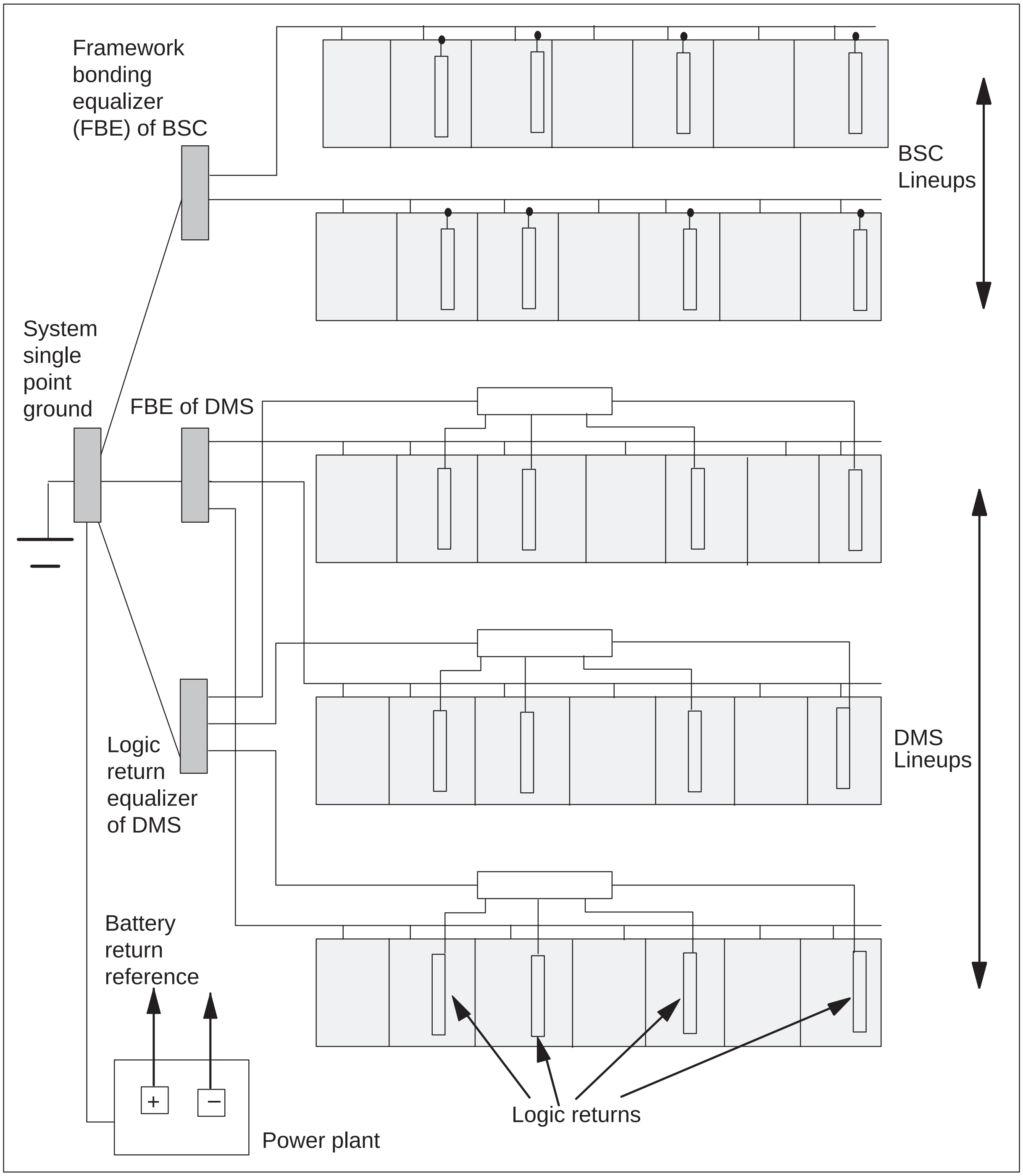
The DMS-100 Wireless switch includes the following grounding requirements relating to the collocation of radio and switching equipment:

- Remove DC current from all communication links between the radio (BSC/BTS) and DMS equipment.
- Do not install switching and radio frames or cabinets into the same lineup. BSC cabinets follow the requirements in ISZX21AA. DMS cabinets follow the requirements in NTP 297-1001-156, *DMS-100 Power Distribution-Grounding Guide.*

- Ground the switching and radio equipment to the same single point ground (SPG) if they are to receive power from the same power plant.

The following figure shows an example of collocated switch and radio equipment.

Collocated switch and radio equipment



Central office grounding

All CO equipment meets Bellcore Technical Reference, TA-NWT-001089, *Electromagnetic Compatibility and Electrical Safety Generic Criteria for Network Telecommunication Equipment* for bonding and grounding information.

Specifically, the equipment's metal frameworks allow for the attachment of grounding cables independent of mechanical connections.

All unit chassis have a grounding stud for termination to system ground.

The ground path is independent of any current carrying return paths of the power or signal distribution cables.

BSC grounding

The BSC is not isolated system ground (ISG) compliant, although it is ISG compatible. This means that even though there is a connection to the same building ground system as the switch equipment, it does not cause this equipment to be non-compliant with ISG.

Digital cross connects isolate the switch equipment grounding network, and the CDMA switching equipment grounding network, for all connections.

Cell site grounding

All metal frameworks of the BTS equipment permit the attachment of a grounding cable, independent of mechanical connections. All unit chassis have a grounding stud for termination to system ground. This ground path is independent of any current carrying return paths of the power or signal distribution cables.

External power supply

Commercial AC powers the system at the CO and all remote locations.

In the CO, there is no need for special external power supply above and beyond the standard CO power requirements.

Refer to the following NTPs for additional information on switch power supply requirements information:

- *DMS-100 Power Distribution-Grounding Guide*, 297-1001-156
- *CDMA 1900 MHz BTS Outdoor Technical Overview,* 411-2133-100
- *CDMA Base Station Controller Theory of Operations Handbook,* 411-2133-101
- *CDMA 800 MHz BTS Technical Overview,* 411-2133-102

- *CDMA 1900 MHz Outdoor BTS Maintenance Guide*, 411-2133-500
- *CDMA BSC Maintenance Troubleshooting Guide*, 411-2133-501
- *CDMA 800 MHz BTS Maintenance-Troubleshooting Guide and 800 MHz BTS Hardware Replacement Manual*, 411-2133-502

Hardware descriptions

The hardware baseline for the Loading switch is the existing wireline switch CM and peripherals, plus the wireless elements for CDMA radio.

The DMS-100 Wireless switch uses existing wireline equipment. To support wireless end users, add a BSC and at least one BTS. The BTSs have a T1 interface into the BSCs. There is no direct interface between the BTSs and the CO switch.

An LPP or FLIS shelf stores the application processor link interface units for CCS7 link interface units (LIU7), CIUs, and CAUs. A separate FLIS/LPP platform isolates the CIU-CAU from other application processors, such as LIU7s.

The BSC connects to the switch equipment through a signaling link to the CIU in the LPP or FLIS, and through a T1 voice link to a DTC7. DTC7s must have the XMS-based peripheral module product life upgrade strategy (XPM Plus) (MX77) configuration.

Use the NT9X10AA series 60 or NT9X10CA series 70EM BRISC processors. The DMS-100 Wireless switch does *not* support the NT9X10BA SR70 BRISC processor. The DMS-100 Wireless switch also requires a system load module (SLM) III NT9X44AD.

Storage of billing data on a magnetic tape drive (MTD) requires a separate tape drive to support the wireless CDR billing records. Connection to downstream processing centers for wireless CDR billing records requires an MPC 1X89 card.

The DMS-100 Wireless switch does *not* support 1X67 cards for wireless voice mail end users. The DMS-100 Wireless switch, where wireless and wireline end users share the same voice mail system, requires a 1X89BA input/output controller (IOC) card.

DTC BSC/BTS link provisioning

The DTC supports 20 T1 link interfaces with 10 NT6X50 cards (two T1s for each card). You can use T1 links to connect

- to the SBS integrated service link (ISL) trunks
- trunks to other wireless offices

- trunks to other wireline offices

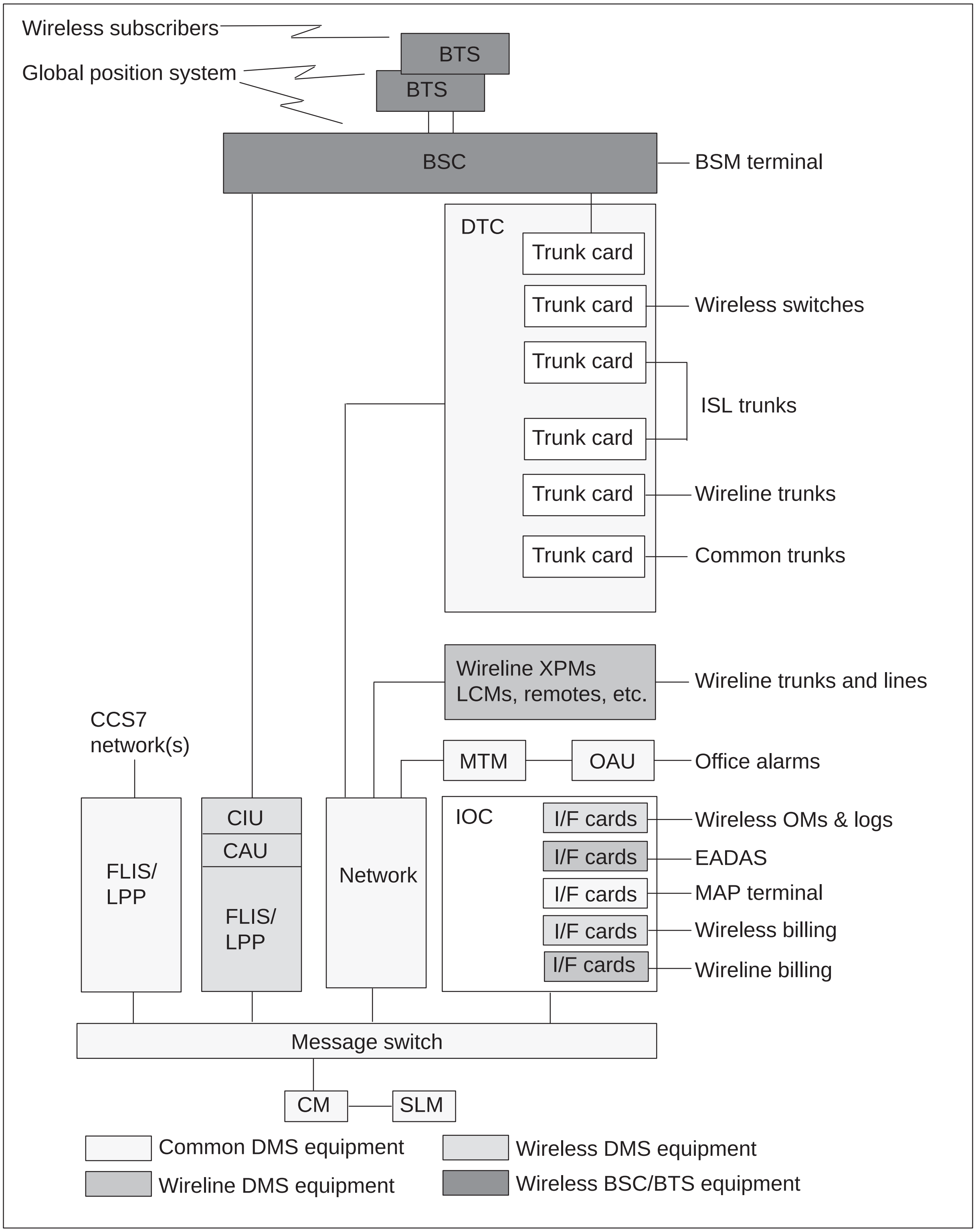
A common DTC can store a mix of trunk cards that link wireless and wireline trunks.

This section divides hardware descriptions into the following categories:

- wireline DMS equipment
- common DMS equipment
- wireless DMS equipment
- wireless BSC/BTS equipment

The following figure, “Internal DMS-100 Wireless switch equipment” shows how each of these groupings make up the DMS-100 Wireless switch.

Internal DMS-100 Wireless switch equipment



Wireline DMS equipment

Wireline equipment for the DMS-100 Wireless switch includes all peripheral equipment that the DMS-100 and DMS-200 switches use. This equipment includes line concentrating modules (LCM), maintenance trunk modules, XMS-based peripheral modules (XPM), and remotes.

The DMS-100 Wireless switch does not introduce wireline equipment not found in the existing DMS wireline products.

Common DMS equipment

The following subsections list the common DMS equipment that both wireless and wireline functions use in the Loading switch.

Computing module

For upgrades, the CM requires at least an SN60 processor. Initial releases of the DMS-100 Wireless switch requires a BRISC series 70EM full SuperNode or SuperNode SE (SNSE) with 70EM configuration. The DMS-100 Wireless switch also requires an SLM III.

Network

The switch network fabric supports junctored network (JNET) and enhanced network (ENET). The network has two planes for full redundancy.

Note: Nortel only supports JNET in upgrade situations from DMS-100 and DMS-200 switches to DMS-100 Wireless switches. (All initial switches include ENET).

Message switch

The message switch (MS) is a fully-redundant, 32-bit wide, 128 Mb/s message bus that connects all DMS equipment. It has a dual-plane, fully-duplicated architecture. The MS operates in a load-sharing mode. This duplication allows either plane to assume a full messaging load without message loss or service degradation.

LPP and FLIS

For CCS7 messaging, the common DMS equipment includes an LPP or FLIS cabinet.

The LPP stores one shelf of redundant local MS equipment, and three shelves for application-specific pack provisioning. (For example, application units handle CCS7 messaging from either wireless or wireline software.)

The FLIS platform, which can hold up to 12 application-specific units connects to the DMS bus through a fiber connection. The wireless function linked to messaging to the CAU-CIUs requires either a dedicated FLIS or LPP platform.

Input/output equipment (IOE) bay

The IOE bay contains the IOC and billing shelves. The IOC shelf is common DMS equipment that stores the MAP interface and billing equipment.

MAP terminal The MAP terminal controls wireless and wireline switching equipment. It is a terminal that connects to the CO equipment through an interface card in the IOC shelf. The MAP does *not* control the wireless BSC/BTS equipment.

Operations Support Systems (OSS) The OSS connect to the switch through cards in the IOC shelf.

Maintenance trunk module (MTM) The integrated service module (ISM) shelf stores the MTMs and contains the following equipment:

- digital recorded announcements module (DRAM) and enhanced digital recorded announcements module (EDRAM)
- office alarm unit
- conference circuits

DRAM-EDRAM The DMS-100 Wireless switch supports DRAM and EDRAM.

Refer to NTP *DRAM and EDRAM Guide*, 297-1001-527, for additional information on DRAM and EDRAM.

Office alarm unit Wireless and wireline functions share the office alarm unit.

Conference circuits The DMS-100 Wireless switch supports the six-port conference circuit card and the conference trunk module card. Wireless and wireline functions share conference circuits.

Refer to NTP *Conference Circuit Guide*, 297-1001-530, for additional information on conference circuits.

Digital trunk controller A common DTC stores a mix of trunk cards that link wireless and wireline trunks. Wireline trunk software controls one end of the ISL trunks, and wireless trunk software controls the other end.

The interface to a SBS uses a universal processor (UP)-based DTC7.

Some digital T1 packs (6X50s) provide interoffice or ISL voice trunks that wireline and wireless software share. These packs reside in common DMS equipment DTCs.

Wireless DMS equipment

The following subsections describe wireless equipment for the Loading switch:

- CAU
- CIU
- digital trunks
- public safety answering point (PSAP) Enhanced 911 Emergency Service (E911) equipment

CAU

The CAUs are redundant load-sharing application processors (a maximum of 14 [7 pairs]). They are responsible for

- CDMA resource allocation
- CDMA call setup
- providing access utilities for applications to access the CDMA configuration data

Each CAU (which uses FRIU hardware) pairs with another (through configuration data), and owns a group of SBSs, for call setup. Should a single CAU (for example, CAU1) go down or be manually taken out of service, its mate (for example, CAU2) takes ownership of CAU1's SBSs. While CAU1 is down, CAU2 handles processing for all of the calls that CAU1 originally set up. If both CAUs go down, all calls set up by those CAUs are taken down.

CIU

The CIUs (which also use the FRIU hardware platform) are redundant load-sharing processors (maximum of 14 [7 pairs]) that provide the messaging interface to the BSC. (The messages can route through the BSC to the BTS.) The interface supports unchannelized T1.

Each CIU mates with another CIU using configuration data. Each CIU accepts messages addressed to it. If a single CIU (for example, CIU1) goes down or operating company personnel take it out of service, its mate (for example, CIU2) continues to accept messages for its own address. CIU2 then begins to accept messages for its mate's (that is, CIU1's) address. If both CIUs go down, the switch takes down all calls that both CIUs set up.

For maintenance information with these links, refer to the following NTPs:

- *DMS SuperNode Data SPAN Frame Relay Service-Maintenance Guide,* 297-5111-501
- *Alarm and Performance Monitoring Procedures*
- *Card Replacement Procedures*
- *Recovery Procedures*
- *Routine Maintenance Procedures*
- *Trouble Locating and Clearing Procedures*

Digital trunks

The wireless portion of the switch controls digital trunk packs. These trunks connect to other wireless offices, wireline offices, or ISL circuits, and reside in common DMS equipment DTCs.

Digital trunks, other than those described in the previous paragraph, connect to the SBS. Only UP-based DTCs interact with the SBS.

PSAP 911 and E911 service

Wireline end use For wireline end users, provision E911 service through either automatic call distribution (ACD) lines or emergency service (ES) trunks that connect to a PSAP.

For more information on wireline E911, refer to the *Translations Guide.*

Wireless end use An emergency feature in the wireless translations allows an end user to route a 911 call to different seven-digit directory numbers (DN), based on the originating cell site. Provision separate emergency pre-translators for different cell-sector combinations in table CDMAPART (Code Division Multiple Access Partition-specific Data).

The terminating line receives no special indication that the call is from a wireless end user. Nor does the cell site or base station receive the location of the called line. Translations routes the call to a location set up to service emergency calls for that particular cell-sector.

Delivery of the calling mobile identification number (MIN) depends on the trunk signaling of the circuit that handles the call, and the caller's calling line identity restricted (CLIR setup). Set up translations to route the call to a trunk that does or does not provide calling number delivery.

The switch does not use called party hold when wireless callers make emergency calls, since it is treated like a PSTN trunk call.

The DMS-100 Wireless switch does not support Type 2C trunks to wireline 911 tandem for wireless end users. This restriction is due to the limitations of the ISUP ISL and the handling of wireless end user 911 routing.

Wireless BSC/BTS equipment

The BSC/BTS equipment consists of control equipment at the CO (referred to as the BSC), and radio equipment at the cell site (the BTS).

The DMS-100 Wireless switch supports one BSC. Traffic limits the number of BTSs for each BSC. The number of BTSs for each BSC cannot exceed 132, with two distribution and consolidation (DISCO) shelves in the CDMA interconnect system (CIS).

Dedicated, unchannelized T1 links connect the BSC and BTS that carry only BSC/BTS traffic. You can dedicate the BTS T1 links for use by a single BTS, or daisy chain them to two or three BTSs.

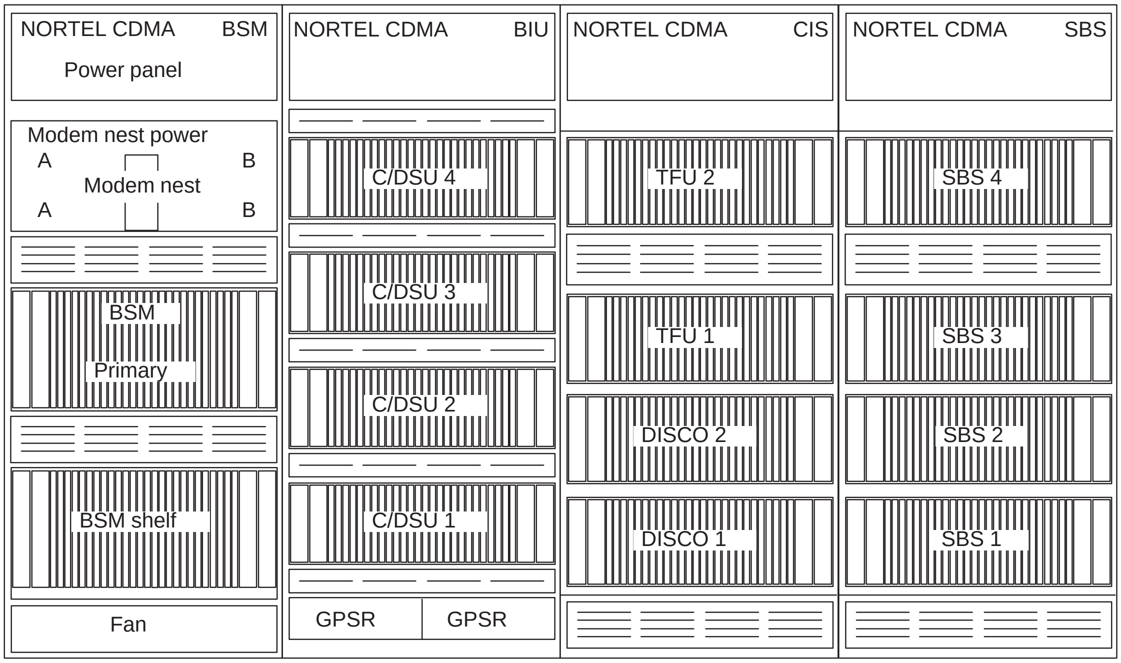
Base station controller

The following functional components comprise the BSC:

- base station manager (BSM)
- backhaul interface unit (BIU)
- CDMA interconnect system (CIS)
- selector back subsystem (SBS)
- power distribution frame

Refer to the following figure "BSC cabinets."

BSC cabinets



Base station manager

The BSM is a workstation platform that runs the UNIX operating system. Equipment to interface the BSM is in the BSM frame. You can set up BSM functionality to display on the MAP terminal, or on a separate terminal.

The BSM, with a dedicated terminal interface, provides a GUI to the wireless BSC/BTS equipment. With the BSM's GUI feature, you can manipulate data with varying levels of access rights or permission levels for different users.

The BSM functions associated with the BSC/BTS include

- performance monitoring
- subsystem testing
- fault management
- maintenance testing
- equipment status
- configuration management

- operational measurement (OM) and log display

You can use the BSM for manual maintenance tests. The BSM also performs the following functions:

- monitors automatic maintenance tests to detect faulty equipment
- dynamically reconfigures the equipment
- generates alarms

The BSM displays the alarm status, which travels to the DMS equipment through the CIU-CAU.

The BSM maintains the current status of all BSC and BTS equipment. While you can automatically take the BSC/BTS equipment out of service, operating company personnel must access the BSM directly to return it to service. Then use the BSM to return components to an active operational state.

A steady-state operating BSM is not necessary for call processing. The BSM is a non-redundant component. If the BSM goes down, call processing continues without interruption.

The following results can occur if the BSM goes down:

- If a device goes out of service, the overall efficiency of the switch degrades. The BSM cannot propagate status changes to other subsystems.
- If a device becomes operational, the switch’s efficiency does not improve to coincide with the newly-available resources.
- The BSM (or MAP terminal) does not display all alarms it reports.
- You cannot manually change the operational status of the BSM’s entities.
- When the CIU-CIS link becomes operational, no call processing begins until the BSM returns to service and sends initialization information to the CM.

Use the BSM to set up system configuration management, based on customer data. The BSM databases configure the BSC and BTS.

The databases have backup mechanisms and administrative files in case of data loss or corruption.

The BSM stores the CDMA database configuration in a master-slave configuration. When the switch makes data changes to the master configuration, the slave configuration also receives those changes. Before the DMS-100 Wireless switch applies data to the master configuration database, both the GUI and table editor interface screen all data. BSM subtending devices (such as the BSC and the BTS) can only have access to the slave configuration databases. The BSM checks for corruption of slave data during periodic self-generated audits. When the BSM finds corrupted data, the master data re-synchronizes with the slave data to restore uniformity.

Backhaul interface unit

The BIU frame stores up to four control signaling unit (CSU)-data signaling unit (DSU) shelves and two global positioning satellite receivers (GPSR). The CSU-DSU equipment provides links to backhaul messages between the BTS and the CIS, and between the CIS and the LPP.

The CSU-DSU provides a physical interface to support T1 and fractional T1 data communications at rates ranging from 56 to 1.536 kbits/s in 56- or 64-byte increments.

A CSU-DSU exists between the CIS and BTS, and between the CIS and CIU. The connection between the CIS and CIU does not support fractional T1 links. If the CSU-DSU-to-CIU connection fails, the CIU’s mate accepts all traffic for both CIUs.

The CSU-DSU itself is non-redundant, but the communication path to the CIU is redundant.

Global positioning satellite receivers

The GPSR provides timing and frequency references to the CIS. The references originate from 24 satellites in 6 inclined orbits. The GPSR synchronizes to the coarse-acquisition code that each satellite broadcasts. The GPSR then derives the satellite atomic clock of 10.23 MHz under the control of a ground master station to analyze the data that a system of monitor stations collected. This derived stratum 1 clock source controls an oscillator in the GPSR to provide the CDMA CO equipment with a stratum 1 level, 10-MHz reference clock. The reference clock also provides a 1-PPS signal to the CDMA CO equipment.

The GPSR has a lightning-protected external antenna. The timing frequency unit (TFU) controller card extracts time-of-day information from the GPSR through the RS-422 interface. The CDMA CO equipment receives the 1-PPS and 10-MHz timing signals.

The CDMA CO equipment has two GPS receivers: one for the primary TFU, and the second for backup. If the GPSR's timing information is not present, all signaling and traffic (BCN) packet transmission and reception cannot occur.

CDMA interconnect system

The CIS performs the following functions:

- It is the hub through which the BSM, SBS, BTS, and LPP communicate.
- It stores the packet router and provides the connectivity and routes data and signaling between the BTS and the SBS.
- It allows the selector function in the SBS to receive and send variable length packets (frames) between BTSs.
- It routes maintenance and call processing messages from the BSM and BTS, to and from the LPP.
- It has redundant traffic and message hardware but does not have a redundant controller.

The CIS frame stores up to two DISCO shelves and two TFU shelves.

DISCO shelf

The DISCO shelf provides

- consolidation, the process of combining several lower rate physical interfaces into a single higher rate physical interface
- distribution, the process of filtering a higher rate physical interface into a set of lower rate interfaces, based on a given criterion (destination address)

The DISCO has BCN ports to the SBS, BTS, BSM, TFU, and LPP. It includes the BCN, two redundant ATM interface cards, and a universal controller card (UCC).

There is one spare BCN interface card. (Move traffic to the spare card when you replace a faulty card.)

An ATM incoming IC fault causes a large number of lost voice and control packets.

If the UCC fails, the CIS goes into a “loss of control“ scenario. In this state, operating company personnel cannot execute operation, administration, and maintenance (OAM) operations on the CIS. (These OAM operations include software download, fault handling, and reconfiguration.)

The TFU provides the DISCO with timing and frequency references. If TFU functionality is lost, all timing information at the CIS is also lost. The switch then cannot route BCN packets (data nor voice).

Selector bank subsystem

The SBS houses the selector and vocoder functions. The transcoder transforms the vocoded signals to PCM and backwards, and routes voice traffic to the DTC.

The CIS links the SBS and the BTS to pass data and signaling information. The selector function maintains soft handoff between multiple base stations.

An SBS frame contains up to four SBS shelves. One office can contain multiple SBS frames.

Each SBS shelf contains the following cards:

- one SBS controller (SBSC) card
- two selector common interface (SCI) cards
- up to 13 selector element cards (SEC) (12 operational cards and 1 card for redundancy)

The SBS is a pooled resource; that is, specific BTSs cannot use SBS resources. It performs RF management functions, such as mobile power control, to minimize interference.

The SBS also provides load sharing capabilities. The more SBSs you provision, the less the impact of an SBS failure on the availability of overall system call processing. More specifically, each SBS that goes down decreases the number of call processing resources available to its CAU.

The SBS has no backup. It is responsible for routing all traffic and data packets to the appropriate SECs. Therefore, if the SBS fails, all calls on the SBS also fail.

The SCI is an interface that transfers voice from the selector elements to the DS-0s in the T1 links that connect the SBS and the DTC. Although the SBS contains two SCI cards, they are not redundant cards. Therefore, when the SCI fails, all voice connections to the DTC also fail.

Each SEC has eight selector elements (digital signal processors), each of which processes one voice call. If an SEC fails, all eight of its calls drop. One SEC failure does not affect calls to other SECs. The BTS resources associated with the calls that drop are free for other SECs to use.

800-MHz BTS

The 800-MHz BTS provides the air interface between the DMS-100 Wireless's CDMA network and the mobile stations. The BTS interface conforms with the IS-95A CDMA standard. The BTS converts end user unit data to (and from) an RF signal from (and to) a digital baseband CDMA signal. The BTS uses CDMA processing to convert the digital vocoded data into RF signals. It sends the product of this conversion through the BSC as data packets. (This transmission also includes control information between the BTS and the wireless functionality.)

The BTS also

- performs local cell site resource management, such as CDMA frequency assignments, and sectorization
- transmits RF power control, backhaul load management, and control of overhead and traffic channel functionality
- performs network management functions, such as configuration performance, and fault management (For example, the BTS uses frame staggering to optimize the backhaul delay performance.)
- implements a dual diversity receiver structure. It supports softer handoff between two of its sectors.

The BTS equipment includes antennas, transmitter, receiver, power amplifier, TFU, and channel signal processing and interface hardware to support the link to the BSC.

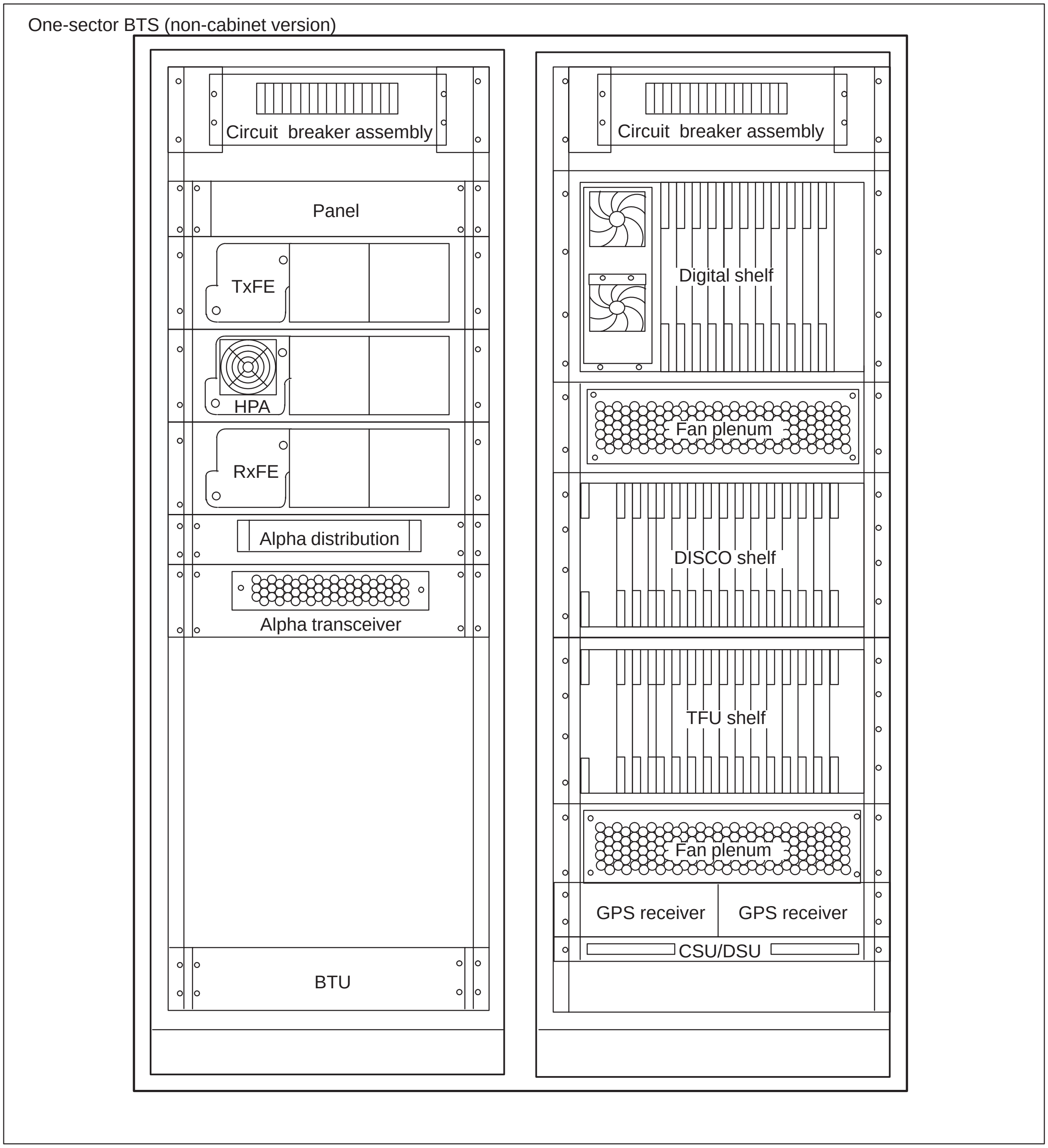
Specific BTS functions are

- over-the-air RF interface with the end user unit
- additional over-the-air functions such as pilot, sync, paging, and access channels
- call processing functions to control the end user unit operation over the paging and access channels
- communication of end user information
- control and management of BTS resources
- control and management communication between the BTS and other base station subsystems

The BTS provides the CDMA radio capability at the cell site. T1 links connect the BTSs to the BSC. You can configure the CDMA cell site as an omni or sectored cell site. Make sure there is at least one BTS for each site to support CDMA channels in an allocated 1.25-MHz frequency band assignment.

The following figure shows the shelf and module arrangement of the racks for an 800-MHz BTS.

800-MHz BTS shelf arrangement



Refer to the following NTPs for additional information on the 800-MHz BTS:

- *CDMA 800-MHz BTS Technical Overview* 411-2133-102
- *CDMA 800-MHz BTS Maintenance and Troubleshooting Guide* and *CDMA 800-MHz BTS Hardware Replacement Manual*, 411-2133-502

1900-MHz BTS

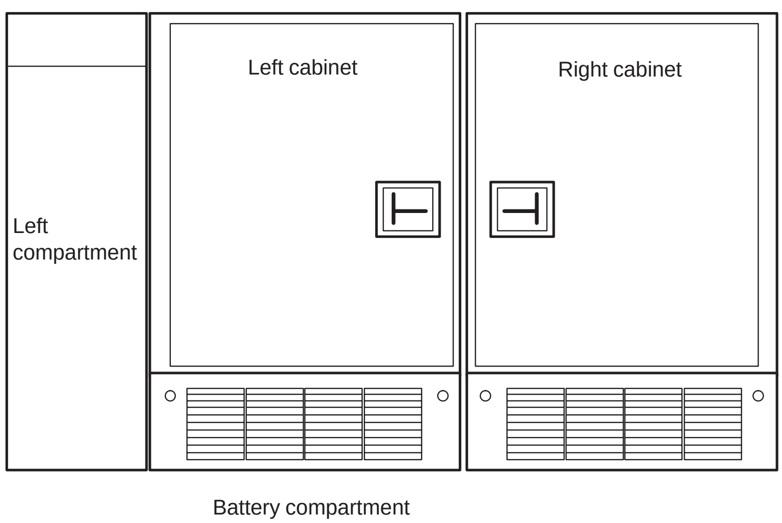
The 1900-MHz BTS is also known as the mini-BTS. It uses CDMA technology to provide the air interface to the mobile end user stations.

T1 links connect the BTSs to the BSC. Mini-BTS configurations include omni (1 sector), two sectors, and three sectors. Each site requires only one mini-BTS to support CDMA channels in an allocated 1.25-MHz frequency band assignment.

The mini-BTS consists of one to three radio frequency front end (RFFE) enclosures and one mini-BTS enclosure.

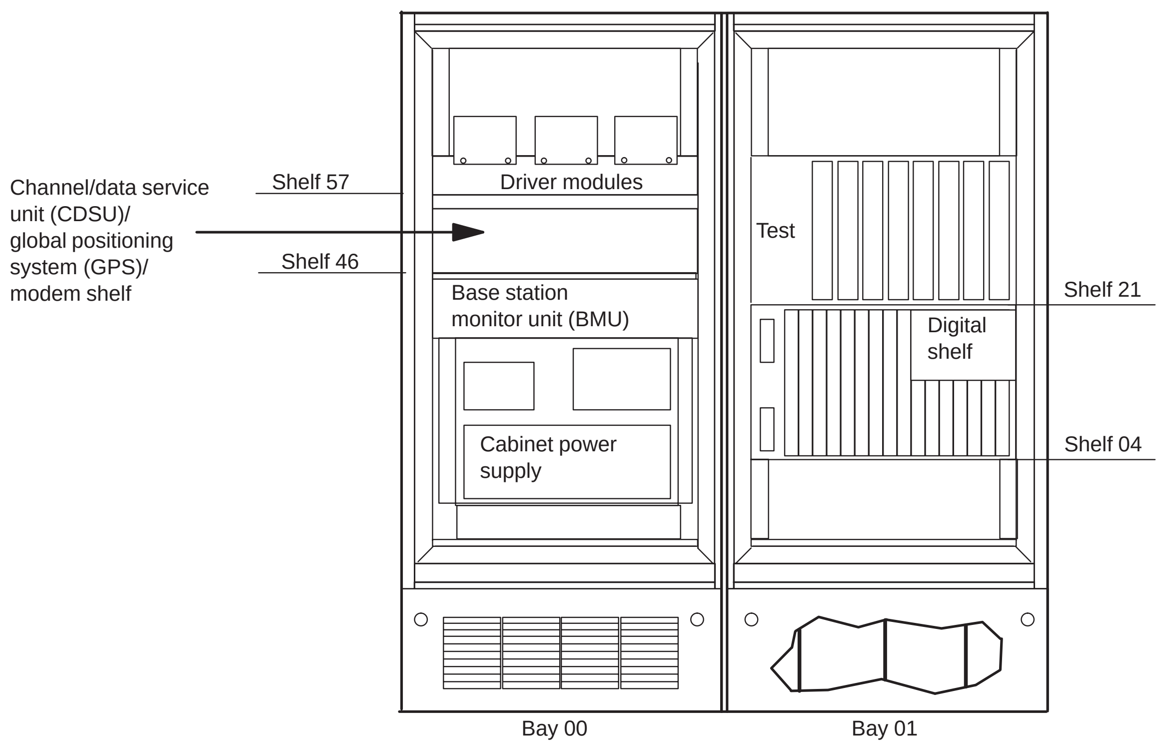
The following figure shows the 1900-MHz outdoor BTS enclosure.

1900-MHz outdoor BTS enclosure



The following figure shows the shelf layout for a 1900-MHz outdoor BTS.

1900-MHz outdoor BTS shelf layout



RFFE enclosure Each RFFE enclosure stores equipment for one sector. Coaxial cable connects the RFFE enclosure to the mini-BTS enclosure. You can place the RFFE enclosure remotely (up to 15 dB) from the mini-BTS enclosure.

You can install its equipment outdoors, on rooftops, building walls, or poles. Each RFFE associates with one transmit-receive antenna and one receive-only antenna (for receiver diversity).

Mini-BTS enclosure The mini-BTS enclosure stores the two frames of equipment, plus batteries and environmental controls.

One frame stores the following equipment:

- RF driver modules
- GSP receiver
- CSU-DSUs
- modem

- battery and power monitoring unit
- rectifier

The other frames store a three-sector transceiver shelf and a mini-BTS digital shelf.

Packaging descriptions

All systems meet network equipment building system (NEBS) Zone 4 seismic requirements.

The BSM is *not* completely NEBS compliant. It does not meet the requirements in regard to disk drives, digital audio tape drives, and CD-ROM drives dropped from a 4-inch height. (Otherwise, it meets NEBS requirements.)

BSC packaging

The BSC is NEBS compliant. The following table lists the physical specifications of the BSC.

BSC physical specifications

Subsystem type	Height m (ft)	Width mm (in)	Depth mm (in)	Weight kg (lb)	Floor loading* kg/sq m (lb/sq ft)	Thermal output kW (kBUT/hr.)
CIS (2 DISCOs)	2.1 (7.0)	750 (29.5)	790 (31.1)	254 (562)	217 (45)	1.4 (4.8)
TFU (1 TF shelf)	2.1 (7.0)	750 (29.5)	790 (31.1)	235 (520)	207.4 (42)	2.5 (8.5)
SBS (3 SBS shelves)	2.1 (7.0)	750 (29.5)	790 (31.1)	338 (735)	284.5 (59)	3.2 (10.8)

Note: For the floor loading measurements, assume half of a 3-ft front aisle and half of a 2-ft rear aisle.

These weight and power dissipation figures depend on the particular BSC frame configuration. (A fully loaded system also determines the precise weight.)

The BSC floor loading meets the maximum 115 lbs/sq ft requirement, as Bellcore specification NEBS TR-NWT-000063 states.

Note: The equipment loading of 115 lb/sq ft plus a 10 lb/sq ft transient loading and a 25 lb/sq ft cable distribution systems and light fixture loading comprise the NEBS specification of maximum 150 lb/sq ft total floor loading.

BTS packaging

1900-MHz outdoor BTS

Environmental cabinets protect the 1900-MHz outdoor BTS from outdoor use. The BTS is remote from the DMS-100 Wireless CO environment. Therefore, it does not fall under the NEBS (TR-NWT-000063) requirements, but is subject to TA-NWT-000487, *Generic Requirements for Electronic Equipment Cabinets*.

Areas of non-compliance with TA-NWT-000487 include

- Main enclosure
  - R-77: battery chamber temperature range
  - R-89: acoustical noise suppression
- RFFE remote from main enclosure
  - R-130: maximum internal air space temperature
  - R-133: cabinet impact resistance
  - R-134: cabinet bullet proof
  - R-139: cabinet fire resistance

The 1900-MHz outdoor BTS consists of an enclosure and one to three RFFEs. The RFFEs allow remote antenna location from the equipment enclosure. The enclosure stores the CDMA electronic and associated power, and environmental control equipment. The RFFE stores the high-power (AMPs) and low-noise amplifiers (LNA).

1900-MHz indoor BTS

The 1900-MHz indoor BTS has two physical components: a mini-BTS and an RFFE enclosure. Each cell site requires one mini-BTS, and each sector requires an RFFE (up to three maximum).

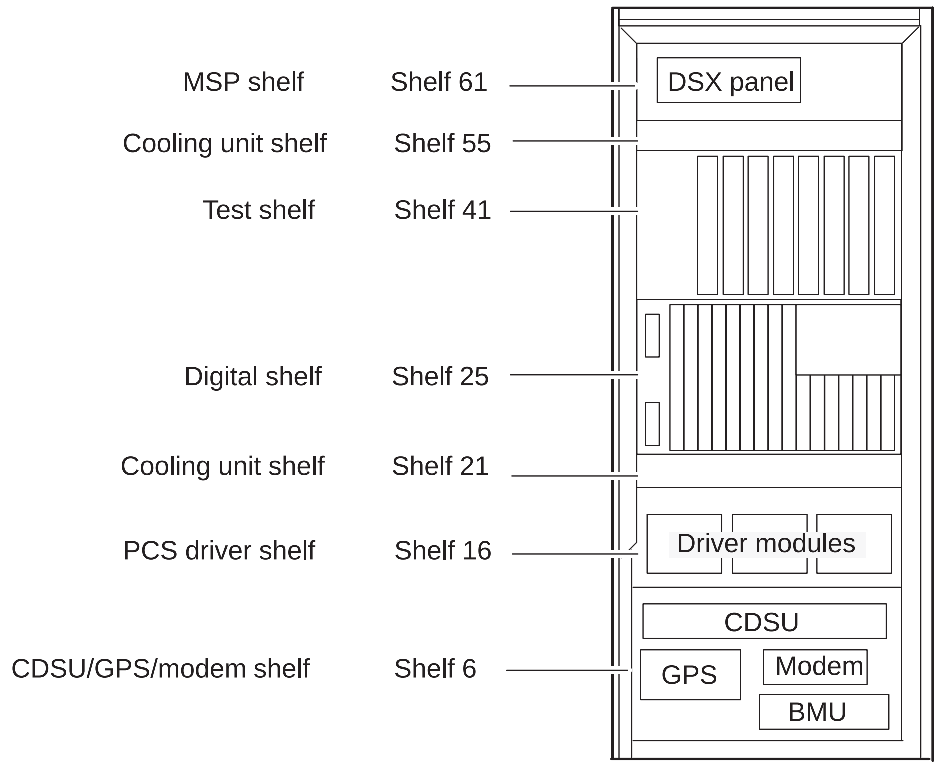
The indoor BTS, housed in a C-28 cabinet, consists of

- equipment cabinet 00 (left side)
- equipment cabinet 01 (right side)
- lower compartment with battery drawer (left side)

- lower compartment (right side)
- end compartment (left end)

The following figure shows the 1900-MHz indoor BTS cabinet.

1900-MHz indoor BTS cabinet



The cabinet has an attached air-to-air heat exchanger for environmental control. The cabinet is modular in design with two front doors measuring 76.260 in. wide, 63.125 in. high, and 30 in. (without heat exchangers) or 40.5 in. (with heat exchangers) deep. A sliding tray on the left side at the bottom of the cabinet stores the back-up batteries. When you close the battery tray, it creates a separate and sealed compartment in the cabinet. The approximate weight of the indoor BTS cabinet with batteries (4-hour backup) is 2800 lbs.

The RFFE enclosure weighs no more than 80 lbs.

> ⚠ **CAUTION**
> **The Occupational Health and Safety Act prohibits the manual handling and carrying of equipment over 50 lbs in weight up and down a pole.**
> Use a machine to help in RFFE installation or removal from its mount on a pole or on the side of a building.

800-MHz BTS

Radio frequency unit (RFU) and digital racks store the BTS equipment. The RFU and digital racks can be either cabinetized or non-cabinetized.

Each rack contains a number of shelves, modules and a chassis. A shelf mounts into a rack by means of a pair of mounting tabs. A module is any unit in a chassis with a backplane. A chassis is any unit having a backplane, with rack-mounted modules.

The BTS contains the following shelves and modules:

- timing and TFU shelf
- GPS shelf
- digital shelf (DS)
- transceiver shelf
- distribution shelf (non-cabinetized version only)
- BTU shelf
- DISCO shelf
- integrated CSU-DSU shelf
- circuit breaker (CB) shelf
- air intake fan plenum (FP) shelf
- air intake and exhaust FP shelf
- integrated CB-FP shelf
- receive front end (RxFE) module
- equipment racks
- HPA module
- transmit front end (TxFE) module
- site alarm panel

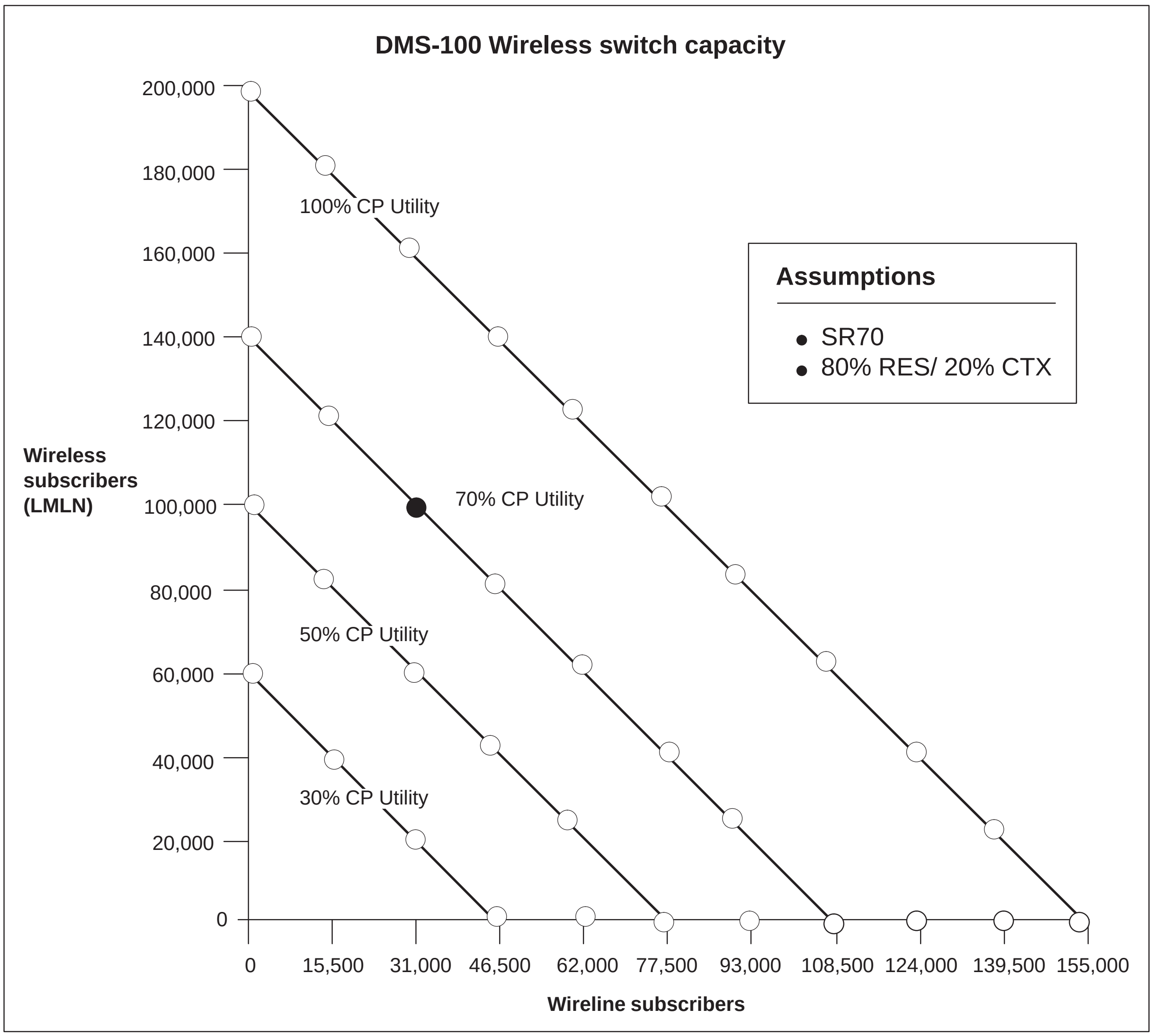
Refer to NTP *CDMA 800 MHz BTS Technical Overview*, 411-2133-102, for packaging and model information.

System capacity

The DMS-100 Wireless switch capacity depends on several factors, such as traffic assumptions and the number of wireless and wireline users on the network.

Refer to the following figure, for an example of a call processing (CP) utilization chart for a switch with an SR70EM processor. This chart shows that if you have 100,000 (98,845) wireless subscribers, the switch is at 70 percent capacity with 31,000 wireline subscribers.

Comparison of wireline and wireless subscribers (low mobility/low networking)–SR70EM



Network compatibility

Network management

Network management (NWM) supervises and controls telephone switching networks to guarantee the maximum flow of traffic under adverse or overload conditions. These conditions can occur when the demand from the switching office exceeds the ability of trunk groups or common control equipment (or both) to provide satisfactory service.

DMS-100 Wireless NWM controls allow operating companies to block or reroute all or some traffic. This call traffic can be destined for, or have originated from, a particular trunk group, based on the number dialed.

You can manually activate NWM controls from the NWM MAP level or from the command interpreter (CI) level. You can activate the NWM controls in response to internal overload conditions in the switch, or to overload signals from scan (SC) points from other offices. The DMS-100 Wireless switch can also signal its own overload condition to other offices using signal distribution (SD) points.

Reroute controls

Reroute controls allow you to reroute a percentage (1–100%) of traffic from a designated route list to another list in the routing chain (out-of-chain routing). You can set up a maximum of 1024 controls, each with up to 16 subroute lists. Only one subroute is active for each reroute control at a time.

To reroute traffic, create the alternate route list (with percentage for reroute) in table REROUTE (Network Management Reroute Control). Then add selector RRTE in the existing translations route list to point to it. Control activation occurs when the RTECTRL level of the NWM MAP issues the APPLY RRTE command with the correct route and subroute numbers.

Auto controls

There are three separate types of automatic controls:

- internal dynamic overload control (IDOC)
- preplaned (PPLN) control
- automatic out-of-chain reroute (AOCR) control

Internal dynamic overload control IDOC is an automatic control that reacts to traffic overload conditions in the switch by transmitting control signals to other offices that indicate the switch's condition. IDOC does not affect internal traffic flow. IDOC also informs other offices to direct traffic away from this office.

The switch sends three levels of IDOC signals in response to the following triggering events:

- Level 1—when the MF receiver queue length exceeds a preset threshold
- Level 2—when CPU occupancy exceeds a preset threshold
- Level 3—by a dead system (usually a restart)

Pre-planned control Also known as remote DOC, signals received on SC points from other offices activate PPLN controls.

Most PPLN controls block partial or all traffic to outgoing trunk groups. The exception is the incoming trunk busy (ITB) control. If the group has option remote make busy (RMB), the switch removes a percentage of the trunks in an incoming (or two-way) group out of service.

The available outgoing controls are:

- Directional reservation equipment (DRE) applies to selected two-way trunk groups. DRE gives priority to incoming traffic by reserving a number of idle trunks in a group. If the number of idle trunks drops below the threshold in the datafill, the switch route-advances all traffic attempting to terminate to this group. (This process is also known as skip-routing.)
- Protective reservation equipment (PRE) applies to selected two-way and outgoing trunk groups. PRE is similar to DRE in that it reserves a given number of idle trunks for incoming calls. The exception is that PRE only acts on alternate-routed (AR) traffic.
- Cancel to (CANT) applies to selected two-way and outgoing trunk groups. CANT blocks traffic to the group by sending calls to NCA, EA1, or EA2 treatment. Set CANT to control either a percentage of AR traffic, or all AR, and a percentage of direct-routed (DR) traffic.
- Cancel from (CANF) applies to selected two-way and outgoing trunk groups. CANF prevents trunk group overflow traffic from continuing to the next group in the route list. It blocks a percentage of overflow traffic from this trunk group by sending the traffic to NCA, EA1, or EA2 treatment.
- Skip (SKIP) applies to selected outgoing trunk groups. SKIP causes a percent of AR or DR traffic to advance to the next group in the route list.
- Selective trunk reservation (STR) is an extension of DRE and PRE, and works with hard-to-reach (HTR) codes. (See subsection “Code controls” in this section for information on HTR.) STR has two idle trunk threshold levels and one datafillable blocking percentage.

  The blocks call to the designated trunk group, as shown in the following table.

STR blocking levels

Traffic type	Level 1% blocked	Level 2% blocked
HTR–DR	X%	75%
HTR–AR	X%	100%
Other–DR	none	X%
Other–AR	none	100%

- Flexible reroute (FRR) allows separate datafillable percentage levels for re-routing AR and DR traffic. You can select EA, non-EA, or both call types. Flexible reroute allows you to enter a VIA route list (that is, common language location identifiers [CLLI], to where the traffic is to be rerouted) in the command line without making any changes to existing translations tables.

Set up all preplaned controls in table NWMPPLN (Network Management Preplan Control) and table PREPLANS (Network Management Preplans).

Automatic out-of-chain re-reroute AOCR is an automatic control that provides extended routing for calls that overflow their in-chain final trunk groups. First enter datafill for an overflow route in table REROUTE, then add control AOCR to table NWMAOCR (Network Management Automatic Out-of-Chain Reroute). When the amount of traffic that overflows the activating CLLI exceeds the activating percentage, traffic diverts to the REROUTE route. If traffic starts to spill over the overflow CLLI and exceeds the overflow percentage, the switch deactivates the control. AOCR activation and deactivation runs in a background process, which checks the overflow rate of the selected trunks every 5 minutes.

Group controls

The group control (GRPCTRL) level of the NWM MAP is the manual equivalent of the automatic PPLN controls. The same set of trunk group controls is available (DRE, PRE, CANT, CANF, SKIP, ITB, STR, and FRR). You cannot set up these trunk group controls ahead of time in data tables. You must first use the SELECT command to pick a trunk group. Then use the APPLY command to apply the desired control. Enter the required parameters on the command line.

Code controls

The CODECTRL level of the NWM MAP selectively blocks calls to area codes, country codes, prefixes, or any dialed-digits string. It can also selectively block calls from a specific area code to the selected destination code.

Code blocking Code blocking (CBK) limits a percentage or rate of traffic from entering a network, according to the destination code (digits dialed). The blocked traffic routes to EA1, EA2, or NCA treatment. The percentage setting ranges from 1 to 100%. Call gapping blocks a specified rate of traffic. It has a range of 0 to 600 seconds set in one-tenth second-increments. (For example, a setting of 10 allows 1 call every 10 seconds to reach the destination code.)

Preroute peg Preroute peg (PRP) is a code control for studying traffic levels to destination codes. PRP maintains a count of all calls to a specified number. It does not block or reroute any calls. View the counts in either the NWM MAP level or OM register group PRP. Operating companies use these pegs to determine when to activate code blocking controls.

Hard-to-reach flag Hard-to-reach flag (HTRF) is a code control that flags certain destination numbers as hard to reach. Set HTRF for all calls to a certain number, or just calls from a specific numbering plan area (NPA) to this number. To flag a call, set a boolean in the call condense block (CCB) (CCB.CHB.XLAB.HTRC) to true. HTRF does not block or reroute calls by itself.

Support for point code

CCS7 signaling uses assigned point codes to identify the nodes that send and receive signaling messages. A point code consists of three parts: network, cluster, and member identifier. BellCore administers North American point codes.

Use table C7NETWRK (CCS7 Network) to define each network to which the DMS node has CCS7 signaling connectivity. Each tuple in the table provides the following identifiers:

- name of the network
- network indicator
- originating point code used when signaling over this network

The following example shows sample datafill for table C7NETWRK.

MAP display example for table C7NETWRK

```
 NETNAME NODETYPE PTCODE      NI SLSROT TFR MCS CLUSTERS RCTEST MTPRES
 ----------------------------------------------------------------------
C7NETWRK1  SSP   ANSI7 54 55 56    NATL   Y          Y      3         Y
                  Y           Y
```

Both wireless and wireline functionalities use the base CCS7 software to restrict the number of definable point codes for the DMS node for a network indicator.

The DMS-100 Wireless switch supports CCS7 signaling to at least two different networks. IS-41 signaling (built on top of transaction capabilities application part [TCAP]) requests end user information from other cellular nodes while processing originations from wireless sets. Calls that use out-of-band signaling route to other nodes, which require CCS7 signaling to the PSTN.

The DMS-100 Wireless switch uses the same point code for signaling to both the NACN and the PSTN. Make sure that the other connected carrier networks have updated service switching point (SSP) and STP routing tables to reflect the node’s point code of the DMS-100 Wireless switch.

Trunk configurations

CCS7 signaling configuration

The DMS-100 Wireless provides XPM and CM software for calls between two agents. They are interworked.

The DMS-100 Wireless switch supports the following types of CCS7 signaling for call processing:

- CCS7 ISUP signaling for wireline-based trunks
- CCS7 ISUP signaling for wireless-based trunks
- TCAP queries for wireline calls for applications such as E800 and CLASS
- TCAP IS-41 messages for mobile calls, for HLR and VLR updates and interoffice handoff

Hardware requirements

From a hardware perspective, the same signaling links can receive either of the four types of signaling messages. You need an LIU7 in the LPP for each signaling link that an office supports. Configure the wireless LIU7s for ISUP and IS41 signaling the same as for wireline ISUP and TCAP signaling.

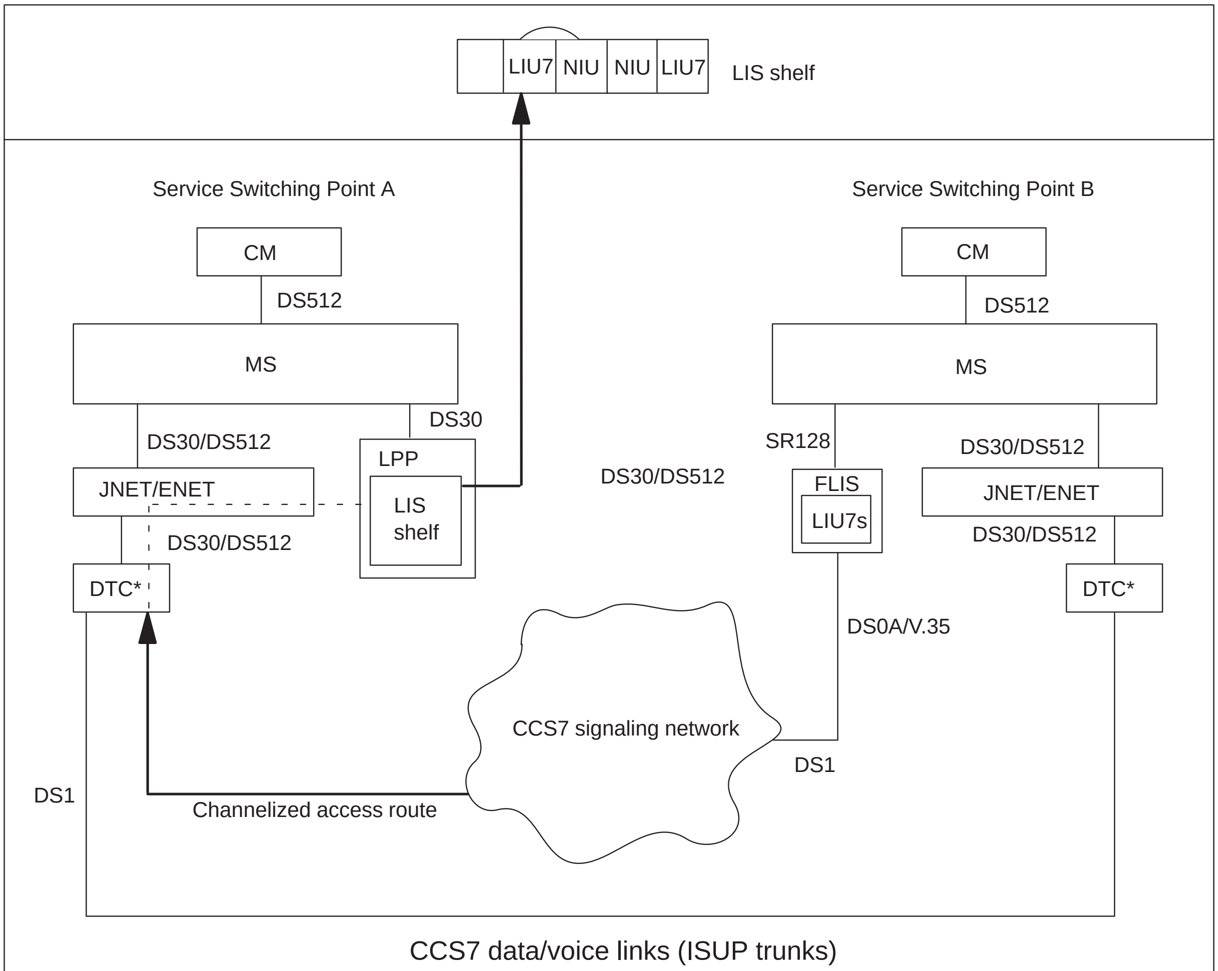
Voice channels for ISUP and NWK trunks terminate as T1 links on a DTC. The configuration of logical trunk groups for ISUP and NWK trunks determines how to configure channel allocation.

Channelized access

The DMS-100 Wireless switch also supports a channelized access configuration.

The following figure shows the hardware configurations for CCS7 signaling. The left portion of the figure reflects channelized access connectivity. Also note that the LIU7s can exist in either an LPP or in an FLIS.

CCS7 hardware configuration



Note 1: These DTCs contain software (and optional hardware, such as continuity cards) that supports CCS7 functionality. They are also called DTC7s.

Note 2: The top portion of the channelized access portion of the figure shows a magnified view of the LIS shelf.

Use the CCS7 signaling links for both the wireline and wireless ISUP messaging, if you configure the voice channels into separate trunk groups. Send wireline TCAP messages (for CLASS and E800) and wireless TCAP messages (for HLR queries and interswitch handoff) on the same CCS7 signaling link. Follow the existing wireline and wireless provisioning rules for the CCS7 tables and data structures.

Refer to NTP *DMS-100 SuperNode Common Channel Signaling 7 Translations Guide*, 297-5151-350, for additional information on CCS7.

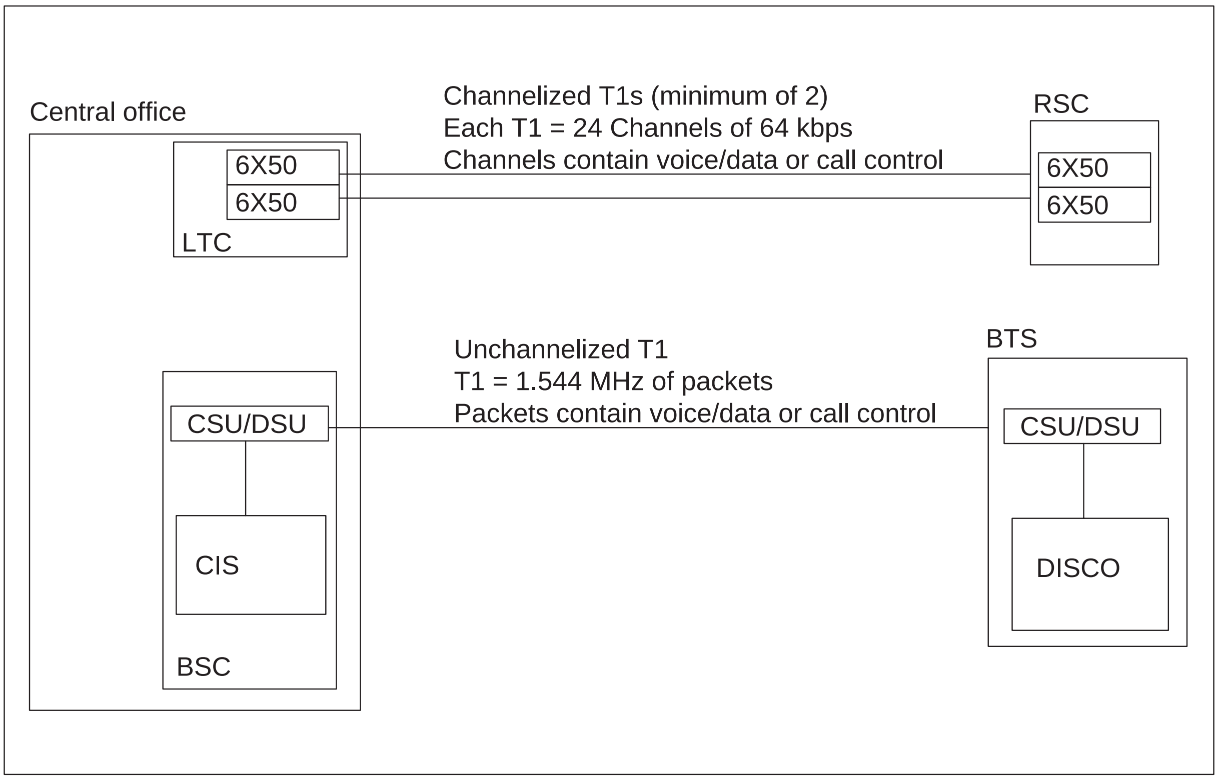
Host remote configuration

The BTS/BSC connection uses T1 links. Some connections do not need the full 1.544 MHz of bandwidth available in a T1.

Use separate T1 links for RSC-CO connections, and BSC/BTS connections. RSC-CO connections and BSC/BTS connections do not share the bandwidth of a T1 link.

The following figure shows an example of the host remote configuration.

Host remote configuration



Feature packaging

The DMS-100 Wireless switch defines the deliverable content, including the wireline functionality and wireless CDMA functionality. The software optionality control (SOC) manages the access to optional wireline and wireless functionality. SOC allows operating company personnel to activate an optional functionality through an electronic control file from Nortel.

SOC options

The Loading switch supports SOC for wireline and wireless functionality options.

Wireline SOCs are adopted, as defined by the NA PCL prime, and are managed on individual established NA processes.

Wireless SOCs include

- State–same management strategy used for wireline SOCs
- Usage–remains consistent with the defined wireline strategy. Nortel sets the orderable limit designations for the wireless usage SOCs to “monitored.”

Network interworking

The DMS-100 Wireless switch supports the following network interfaces:

- PSTN network—MF and CCS7 trunks (types 1, 2A, and 2B) to the PSTN. An end user in the PSTN network can make and receive calls from a PCS end user.
  - — type 1, to an end office, carries traffic run in tandem through the end office
  - — type 2A is to an wireline tandem
  - — type 2B is to an end office carrying traffic originating and terminating only on that end office
- all specific wireline interfaces (including POTS, ISDN and P-phone lines). The switch also supports wireline Centrex capabilities.
- cellular networks—MF and CCS7 trunks to cellular switches (types 1, 2A and 2B). A cellular end user can make and receive calls from a PCS end user.
- PCS networks—MF and CCS7 trunks to other wireless switches in the same or different PCS network. These trunks handle call handoff.
- wireline 911 tandem—type 2C trunks to wireline 911 tandem trunks route 911 emergency calls
- STP interface—CCS7 links to an STP

- Service control point (SCP) interface—CCS7 links to SCP and VLR elements (including advanced intelligent network [AIN] 0.1/0.2 over TCAP)
- ISUP trunks—according to TR-317 procedures, to other wireline switches
- IEC networks—MF and CCS7 (according to TR-394) trunks to IEC networks
- Voice mail interface with Simplified Message Desk Interface (SMDI) links
- OAM interfaces—required operations support systems (OSS) interfaces

Performance

The introduction of wireless functionality into the wireline load does not degrade the operation, quality and performance of the wireline product, as measured and reported in *Reliability and Quality Measurements for Telecommunications Systems (RQMS).*

The wireline product has no more than 1.25 cutoffs each 10000 calls. It does not have an individual line or trunk out of service more than 28 minutes each year. The wireline product has no individual D-channel out of service for more than 20 minutes each year. The wireline product has no more than 3 minutes of unplanned downtime each year.

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